ZIEGLER ELECTRIC CO

MANUFACTURERS

of SCIENTIFIC APPARATUS

BOSTON·MASS·

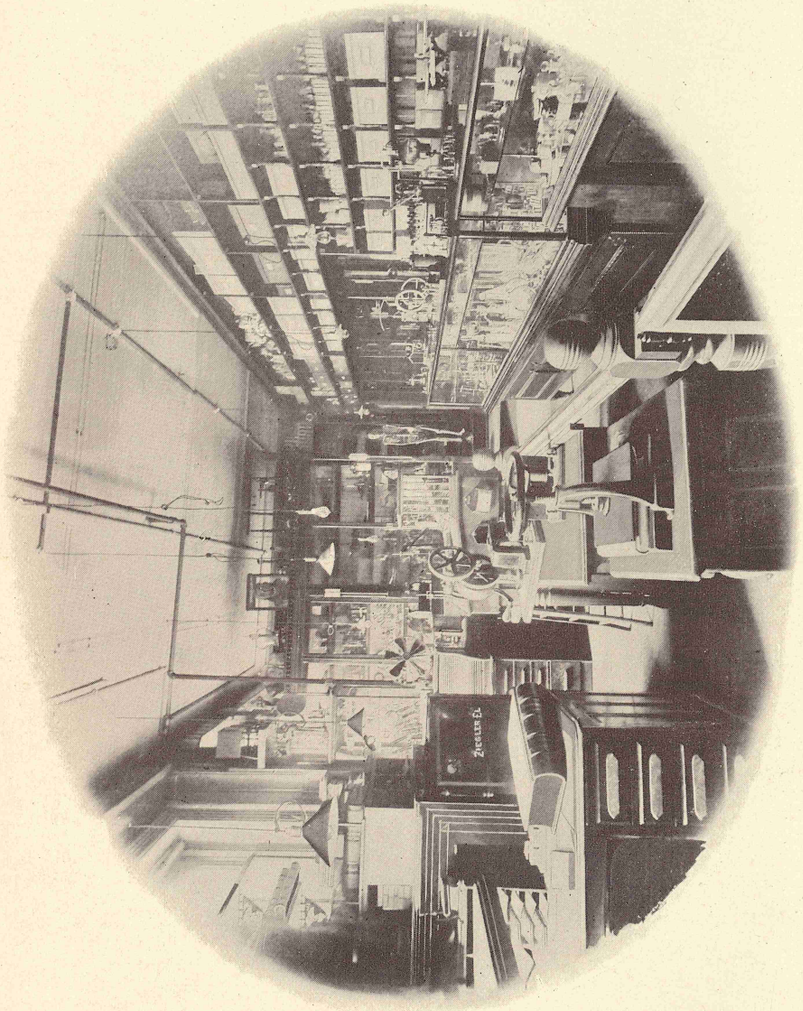
·U·S·A·

ESTABLISHED 1852.

INCORPORATED 1894.

ZIEGLER
ELECTRIC CO
MANUFACTURERS
OF SCIENTIFIC
APPARATUS
BOSTON MASS
U·S·A·

$150



A PART OF SALES DEPARTMENT.

All Former Price-Lists are Hereby Cancelled.

1896.

PRICED AND ILLUSTRATED

CATALOGUE

No. 8,

OF

Physical Apparatus and Supplies.

A. A. ZIEGLER,
Pres't and Gen'l Mgr.

C. L. ZIEGLER,
Treasurer.

J. O. ZIEGLER,
Sec'y and Elec. Eng'r.

Ziegler Electric Company,

Established 1882.

Incorporated under Laws of Massachusetts, 1894.

Manufacturers, Dealers, and Importers.

No. 141 FRANKLIN, cor. FEDERAL ST.,

Long Distance Telephone Connection.

Boston, Mass., U. S. A.

Compliments of Ziegler Electric Co.

Price, $1.00.

Catalogue No. 2797

To Potter Academy,
Sebago,
Me.

ZIEGLER ELECTRIC COMPANY,

BOSTON, MASS., U. S. A.

Entered according to Act of Congress, in the year 1896, by Ziegler Electric Co., in the office of the Librarian of Congress at Washington.

Preface.

IN the preparation of this our new General Catalogue, we have endeavored to make not merely a list of prices, but a guide as well for those who are purchasing apparatus or appliances for the physical laboratory or lecture-room. It is especially adapted to such works as Gage's series of text-books on Physics, and "Physical Laboratory Manual and Note Book," Hall & Bergen's Physics, as well as to the National Course of Physics, as recommended by the famous "Committee of Ten."

It should also be noted that in designing our apparatus, we have had reference to the works of the following well-known authors, viz: *Allen*, *Appleton*, *Avery*, *Barker*, *Carhart*, *Chute*, *Daniell*, *Deschanel*, *Ganot*, *Gifford*, *Glazebrook & Shaw*, *Hopkins*, *Jones*, *Peddie*, *Nichols & Franklin*, *Sabine*, *Shaw*, *Steele*, *Stewart & Gee*, *Trowbridge*, *Whiting*, *and Worthington*, and experiments described in these works can be very satisfactorily demonstrated by the instruments herein described, even though in some cases the appearance of the instrument may not be precisely as indicated in the books.

The instruments enumerated are mainly of our own manufacture, and we have omitted everything obsolete. Many new instruments have been added which do not appear in any of the previous editions of our catalogues, but all of them have been thoroughly tested.

Our extensive knowledge and experience in each of the various branches of our trade enable us to obtain full and correct information respecting any new instruments and inventions; hence we are in a position to supply our correspondents with specialties not described in this catalogue.

We are at all times ready to give or take suggestions from those who contemplate the purchase of apparatus, and will gladly show any instruments in operation to such parties as can make it convenient to call at our office.

We have been compelled to use in this edition an entirely new system of numbering; we would therefore caution our patrons to mention the edition from which they are ordering.

Whenever reference is made to any text-book, the latest revised edition of the work is meant.

Having our factory connected with our warerooms and office equipped with the latest improved machinery, and employing experienced workmen, we can promptly make to order, in the best manner, any new apparatus, and assist inventors on favorable terms in the practical development of new ideas. We solicit your orders for any special glass work, as we employ experts in that line.

Having foreign connection and cable code, we are prepared to import, at short notice, any desired apparatus of foreign make, duty free. Those wishing us to place their orders will send to us for blank forms, to be filled out and returned with the order.

For the convenience of our patrons west of the Rocky Mountains, Messrs. JOHN TAYLOR & Co., No. 63 First Street, San Francisco, Cal., carry a complete line of our physical apparatus, which they will furnish at our list prices, merely adding the freight; and, as very low rates are now had by steamer, via Panama, the cost of laying down our goods in San Francisco is very low.

Important Notice.

Use This Edition Exclusively in Making Orders.

ORDERING. Write order both *legibly* and *explicitly*. Mistakes that occur are usually chargeable to poor chirography or vagueness. Designate the articles wanted by their numbers.

State to whom the goods are to be charged; if to a school board or corporation, written evidence to that effect should accompany the order.

In giving your address state your *full name*, your post-office and express address, mentioning county and State in which you live.

PRICES. Prices are invariably net for ordinary purchases. They are subject to change from time to time to correspond with any change in the cost to produce; made less when we can avail ourselves of improved methods of manufacture, or of a fall in the price of material or duties; or increased when necessitated by similar causes.

No discounts are allowed to "the trade," as we prefer to deal directly with school officials, whom we consider entitled to the lowest possible prices.

REPAIRING. In sending apparatus for repairs, pack carefully all the parts of each instrument and send to us, prepaying the charges. Until the parts have been examined here the cost of repairs cannot be given. When requested, an estimate will be furnished before commencing work, but in every case the charge will be a reasonable one. Should we find that for any reason it will not pay to repair an article, the sender will be frankly advised of the fact.

TERMS. Purchasers having no account with us must send cash with the order, or satisfactory references to justify us in opening an account; or, if it is desired to have goods sent "C. O. D.," this can be done if an amount sufficient to cover all express charges accompanies the order.

All bills not otherwise arranged for are due within thirty days of their date, and monthly accounts on the 10th of each month (without discount or allowance for cash). Bills and accounts not promptly paid as above are liable to interest.

REMITTANCES. Remittances should be made by bank drafts, or post-office or express money orders, payable to the order of the Ziegler Electric Co. All remittances are at the expense and risk of the sender.

PACKING. All goods will be packed with the utmost care by experts, and purchasers must assume all responsibility for breakage and damage during transportation. All packing will be charged for at cost, but we will gladly rebate the charge upon receipt of the packing material used, providing it is in good order and *express prepaid*.

SUGGESTIONS FOR SHIPPING. Experience has shown us that it is advisable to have all ordinary purchases sent by express. It is a quick and reliable way and express companies are responsible for damage.

We are sometimes requested to send an order by freight when the package is so small that the freight company will not accept it; or, again, by mail when the package does not meet the post-office requirements. We would suggest that to avoid correspondence, our customers allow us to send their orders by whatever way seems most practicable. If it is a large shipment, we will send by freight unless otherwise directed. Mail packages will be sent at the risk of the purchaser, and postage for same will be charged for.

All former price-lists are hereby cancelled.

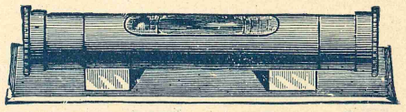
Ziegler Electric Co.'s Catalogue.

Miscellaneous Articles for General Use in Physical Laboratories.

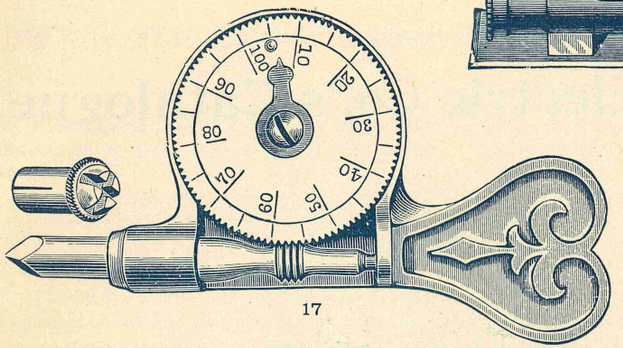
Tools, Instruments of Measurement, Etc.

No.		Price.
1.	**Anvils,** heavy, for table use, with horn, weight, 1 lb., 75 cts.; 2 lbs., $1.50; 5 lbs., $2.00; 10 lbs.	$3.00
2.	**Anvil Clamp Vise,** 1½ in. jaws, opens 1¾ ins.	.65
3.	**Anvil Clamp Vise,** 2 in. jaws, opens 2¼ ins.	1.75
4.	**Anvil Clamp Vise,** 2½ in. jaws, opens 2¾ ins.	2.60
5.	**Cold Chisel,** cast steel, ½ in.	.25
6.	**Calipers,** double (for outside and inside measurements)	.40
7.	**Punches,** cast steel, hollow, ¼ in., 20 cts.; ⅜ in., 25 cts.; ½ in.	.30
8.	**Bit Stock,** good	1.00
9.	**Set of Auger Bits,** 3/16, ¼, 5/16, ⅜, ½, ¾ in., and screw driver	1.75
10.	**Pliers,** gas burner, 6 in., double joints	.60
11.	**Pliers,** flat points, 5 in., 25 cts.; 6 in.	.35
12.	**Pliers,** steel, end cutting, 5 in., 75 cts.; 6 in.	.85
13.	**Pliers,** steel, flat nose and cutting combined, 5 in., 75 cts.; 6 in.	.85
14.	**Plumb Bob,** of japanned iron	.10
15.	**Hammer,** claw, steel	.60

No.		Price.
16.	**Pocket Level,** brass, nickel plated, 3 in.	$ .50
17.	**Speed Indicator,** nickel plated	1.00

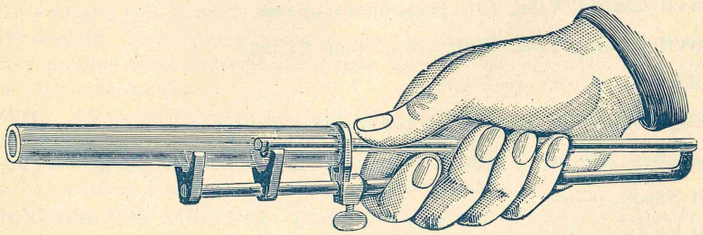


16



17

18. **Universal Pencil Compass;** adjustable, can be quickly attached to any common lead pencil, is true and accurate; including pencil with attached erasing rubber, each 12 cts.; per doz. . $1.25
19. **Dividers,** spring steel, 6 in. 65
20. **Dividers,** plain brass, 6 in. 25
21. **Emery Cloth,** per quire, assorted, No. 00 to 1½ 1.10
22. **Emery Paper,** „ „ „ „ „ „ 45
23. **Emery Powder,** per lb. 12
24. **Emery Flour,** „ „ 10
25. **Fine Wire Sieve,** with handle 50
26. **Glass Cutter,** chilled steel wheel, for cutting glass plates, best . .15



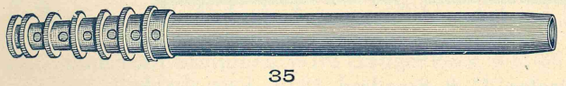
27

27. **Glass Cutter.** The instrument illustrated above is offered as the best inexpensive glass cutter ever produced. We claim for it the following special advantages:
    1. It cuts a perfect circle, because the glass is held in the fiber rests in a parallel position.
    2. No trouble to renew wheel.
    3. Will cut a greater length of glass from end than any other cutter. A valuable instrument at a low price . . 1.00

No.		Price.
28.	**Shears** for cutting metals, 2½ in. blade	$1.50
29.	**Round File** for cork boring, 6 in., with handle	.12
30.	**Three-Cornered File,** 5 in., with handle	.12
31.	**Cork Knives,** each	.25
32.	**Corks,** best quality, cut from selected wood, regular length, assorted sizes, gross	1.00

Quotations on corks of any size and shape given on application.

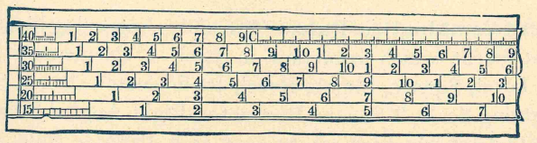
33. **Corks,** of Rubber (see Rubber Stoppers).
34. **Cork Borers,** hard brass, polished, three to set 60
35. **Cork Borers,** „ „ „ six „ „ 1.00



35

36

36. **Cork Press,** iron, bronzed, new grape pattern, very strong . . .50
37. **Cork Press,** „ nickel-plated 1.00
38. **Forceps,** steel, plain, 4 in. 12
39. **Forceps,** brass, straight 20
40. **Forceps,** „ ends bent; this style is especially convenient for picking up small light weights 20
41. **Forceps,** brass, ends bent, but provided with ivory tips 60
42. **Yard Stick,** maple, with brass tips 25
43. **Yard Stick,** „ without tips 20
44. **Yard Stick,** narrower than the preceding 12
45. **Quart Measure,** tin, graduated in half pints 15

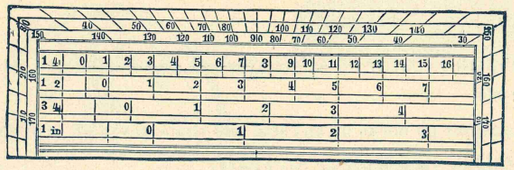


46

46. **Boxwood Plotting Scales,** 6 in. 10

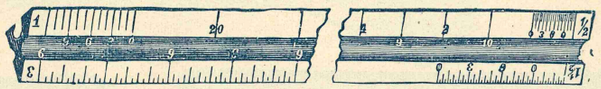
No. Price.

47. Boxwood Protractor, 6 ins. long, $1\frac{3}{4}$ in. wide; scales $\frac{1}{8}$ in. to 1 in. to the foot, by one-eighth the scale of chords, diagonal and decimal scales . . . . . $ .65



47

48. Boxwood Protractor, 6 ins. long, $1\frac{3}{4}$ in. wide; scale $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1 in. to the foot, scale of chords and diagonal scales 40

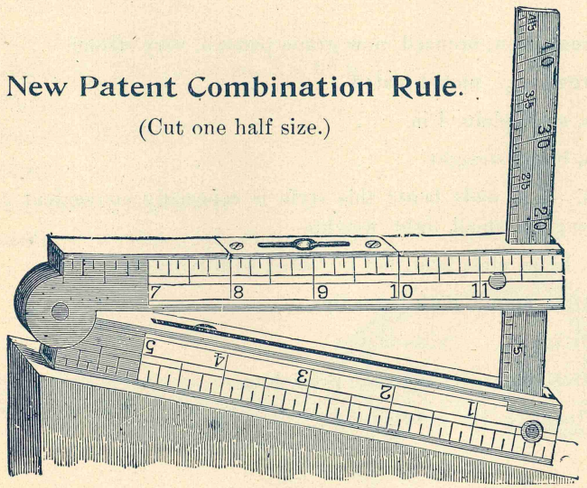


49

49. Boxwood Triangular Scales, U. S. Standard, 12 ins. long, divided to $\frac{1}{16}$ in.; also ten different scales to the foot 1.50

New Patent Combination Rule.

(Cut one half size.)



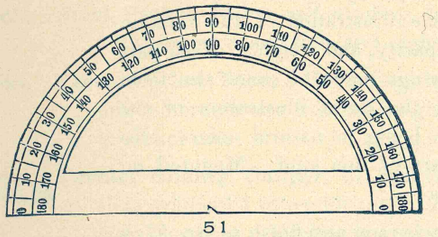
50

50. New Patent Combination Rule. The above engraving illustrates an instrument which combines in itself a Carpenter's Rule, Spirit Level, Square, Plumb, Bevel, Inclinometer, Brace Scale, Draughting Scale, T Square, Protractor, Right-Angled Triangle, and with a straight edge can be used as a Parallel Rule, all of the parts of which in their separate application are perfectly reliable. A full explanation of the rule accompanies each instrument 2.00

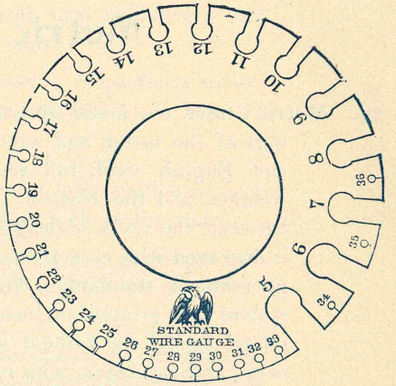
No. Price.

51. Brass Protractor, silvered, semi-circular, $3\frac{1}{2}$ in., divided to 1° . $ .15

52. Brass Protractor, semi-circular, $5\frac{1}{8}$ in., divided to $\frac{1}{2}$° 50



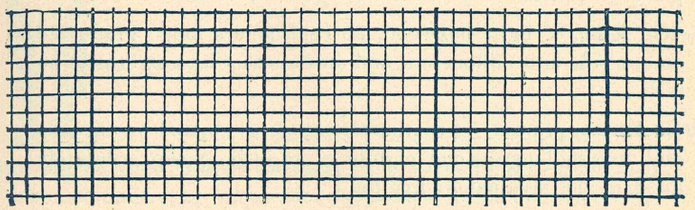
51



53

53. American Standard Wire Gauge, sizes, 0 to 36 . . . . . 3.25

54. American Standard Wire Gauge, sizes, 5 to 36 . . . . . 2.50



55

55. Profile or Cross-Section Paper, lithographed in $\frac{1}{10}$ inch divisions, size, 24 x 31 ins., per sheet 15

56. Cross-Section Paper, lithographed in 1 millimeter divisions, size, 6 x 8 ins., per sheet 10

(Special prices in different sizes and large quantities.)

N. B. — Send thirty cents for our little Note Book of Tables, Diagrams, and Useful Information. See page 24.

Metric Apparatus.

No. Price.

57. Metric Chart, one meter square, on which is shown full-sized drawings of the meter and subdivisions, comparison of the meter and English yard, full set of capacity measures and brass weights, and the clearest possible illustration of the relation between the units of length, capacity, and weight. Each part is engraved with care from drawings made of exact size from government standards. This is the finest illustration of the system ever printed, *all* measures being in natural colors. No school should be without a chart of this kind. Mounted on cloth, and varnished, with rollers $2.00

58. Metric Chart, possessing the same accuracy and finish as No. 57, a meter wide, and 75 centimeters long. New engravings are introduced in this chart, the iron weights, the metric coinage, the relations of the body in the metric units, the centigrade thermometer, etc., so that it supplements rather than takes the place of No. 57 . . . . . 2.00

255. Metric Rule, of light boxwood, 30 centimeters long; graduated on one side into millimeters, and on the other into eighths of an inch 10

59. Metric Rules, printed, 30 centimeters long; graduated on one side both into millimeters and eighths of an inch; cheap, accurately divided, and invaluable; five for 10

255

60

60. Columbia Steel Rules, 6 ins. long, graduated into millimeters on one side and one-hundredths of an inch on the other. Used for comparing millimeters with inches, etc. These rules are made extra heavy, and are well adapted for physical laboratories, etc. 75

61. Brown and Sharpe's Standard Steel Rule, 10 centimeters long . .75

62. Meter Stick, graduated into millimeters on one side, and eighths of an inch on the other 25

63. Meter Stick, graduated into millimeters on one side, and eighths of an inch on the other, with brass-tipped ends 30

No. Price.

64. Meter Stick, graduated on one side both into millimeters and eighths of an inch . . . . . $ .25

65. Meter Stick, graduated on one side both into millimeters and eighths of an inch, with brass-tipped ends 30

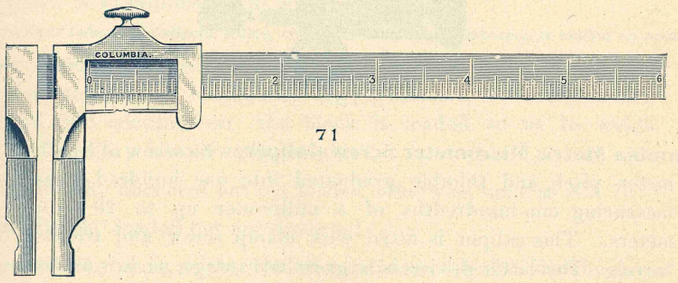
66. Meter, square section stick, four faces, showing respectively meter, decimeter, centimeter, and millimeter divisions 75

67. Meter, folding, in boxwood 20

68. Steel Pocket Tapes, self-winding, 1½ meters long, graduated into millimeters on one side, and eighths of an inch on the other . 1.60

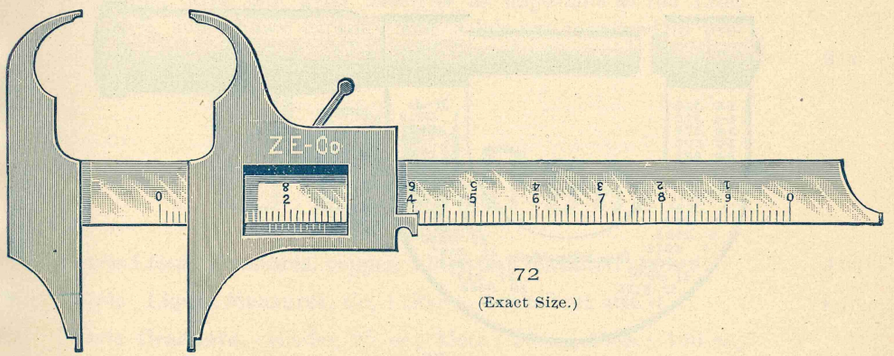
69. Linen Pocket Tape, self-winding, 1½ meters long; graduated into millimeters on one side and eighths of an inch on the other; in nickel case 50

70. Vernier Sliding Caliper, of best German make, 12 centimeters, slide graduated into millimeters, 2 in. jaws for inside and outside measurements. Vernier is graduated to read $\frac{1}{10}$ millimeter . 1.75



71

71. Columbia Vernier Sliding Caliper, 10 centimeters, slide graduated into millimeters, 1¼ in. jaws for outside and inside measurements. Vernier is graduated to read $\frac{1}{10}$ millimeter 2.50

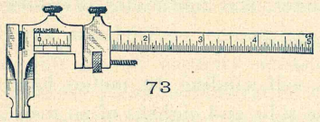


72
(Exact Size.)

72. Vernier Sliding Caliper, 10 centimeters, slide graduated into millimeters, for measuring inside and outside diameters and thickness of tubing; an accurate and well-made caliper . . 2.50

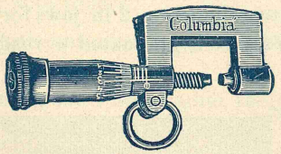
No. Price.

73. **Columbia Vernier Caliper,** $1\frac{1}{4}$ in. jaws for outside and inside measurements, with clamp and screw adjustment. 4 in. slide graduated on one side into $\frac{1}{4}$ millimeter, with vernier to read one one-hundredths; on the other side in twentieths of an inch, with ernier to read one one-thousandths $7.00



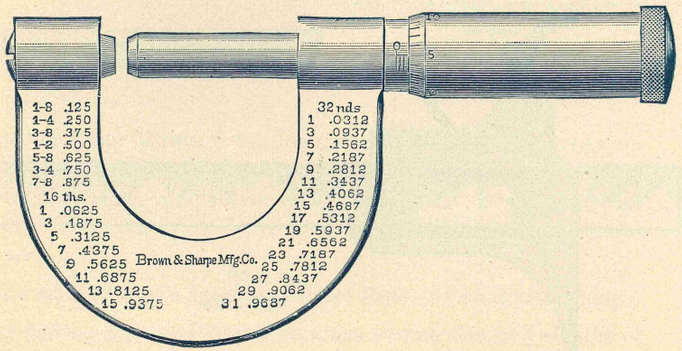
73

74. **Columbia Vernier Sliding Caliper,** 15 centimeters, slide graduated into millimeters, $1\frac{3}{4}$ in. jaws for inside and outside measurements. Vernier is graduated to read $\frac{1}{10}$ millimeter 3.00



75.

75. **Columbia Metric Micrometer Screw Caliper,** with screw of 1 millimeter pitch, and thimble graduated into one hundred parts, measuring one-hundredths of a millimeter up to 20 millimeters. This caliper is fitted with clamp screw and friction barrel. The latter device is a great advantage, as it is almost impossible to strain the instrument; adopted by leading educational institutions throughout the country 6.00

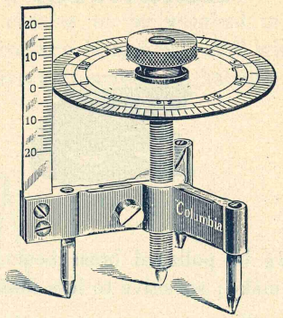


76.

76. **Brown & Sharpe's Metric Micrometer Caliper** measures hundredths of millimeters 4.50

No. Price.

77. **Columbia Spherometer,** reading to $\frac{1}{100}$ of a millimeter, with tripod stand and 2 in. circle. The measuring screw is 40 millimeters in length $10.00



77.

78. **Columbia Spherometer,** reading to $\frac{1}{1000}$ of a millimeter (friction head), with tripod stand and 2 in. circle. The measuring screw is 40 millimeters in length 25.00

Special lists of Columbia Calipers, Rules, and other measuring instruments mailed on application.

79. **Liter Block,** polished mahogany decimeter cube, dissected, and separable into 1 centimeter, 10 centimeters, 100 centimeters, and 900 centimeters; the block is loaded so as to weigh 1 kilogram; almost indispensable 2.50

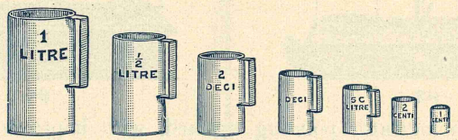
80. **Liter Block,** dissected but not loaded, otherwise same as No. 79 . 1.50

81. **Liter Block,** loaded but not dissected 1.25

82. **Liter Block,** plain, neither loaded nor dissected, polished mahogany .75

83. **Liter Block,** plain, cheap form 25

84. **Liter Case,** graduated brass rule, stop-cock, polished and lacquered copper, with one glass face; is as important as the Liter Block, and shows capacity and solids are measured in precisely the same way 3.00



85, 86.

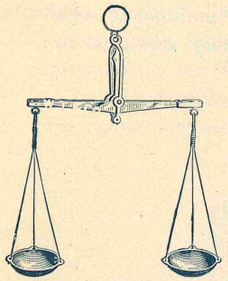
85. **Metric Liquid Measures,** copper, 1 liter to 1 centiliter, per set . 4.00

86. **Metric Liquid Measures,** tin, 1 liter to 1 centiliter „ . . 1.75

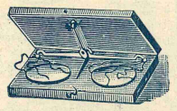
87. **Metric Graduate,** cylinder, 25 cc., 45cts.; 50 cc., 60cts.; 100 cc., 80cts.; 200 cc., $1.00; 300 cc., $1.50; 500 cc., $1.75; 1000 cc. . 2.50

88. **Metric Graduate,** conical, 100 cc., or grms., 60cts.; 200 cc., or grms., 80cts.; 500 cc., or grms., $1.20; 1000 cc., or grms. . 2.00

Balances.



89



91

92

No. Price.

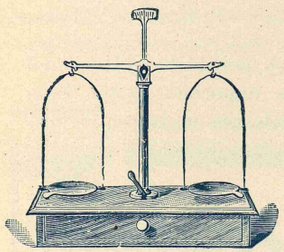
89. **Hand Balance,** with 7½ in. polished brass beam, and large horn pans of fine Berlin make; sensitive to less than 1 centigram . $2.25

90. **Adjustable Suspension Frame and Support** for No. 89, making it adaptable for use in weighing solids as well as for specific gravity work 60

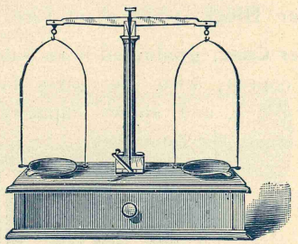
When used for the latter purpose, the object is suspended by a thread passing from the beam through a hole in the pan. When so ordered no extra charge will be made for boring holes in pans. This balance and support makes an extremely cheap and efficient apparatus for specific gravity work.

91. **Balance,** German, beam 6 in., pans 2¼ in., with set of Troy weights, in box 75

92. **Balance,** English, pans 2½ in., steel beam, strictly reliable and very sensitive, set of Troy weights, in oak box 1.25



93



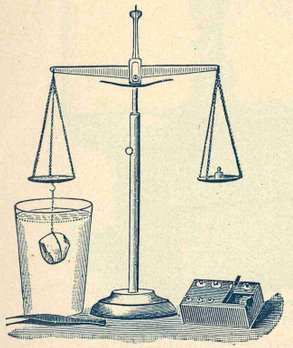
94

93. **Balance,** with indicator pointing upward, with improved raising apparatus; scale can be taken apart and packed away in drawer of box; entire scale is heavily nickel-plated; beam 6 ins. long, pans 3 ins. in diameter, very sensitive 3.00

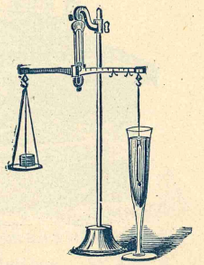
94. **Balance,** sensitive to ½ grain, on polished walnut box, with drawer; total height 11½ ins., has nickel-plated pans 2¾ ins. in diameter, indicator pointing downward, slide attachment on needle, which, if moved to the right or left, will quickly balance the scale; a full set of weights, 2 drachms to ½ grain included . . . 8.00

No. Price.

95. **Specific Gravity Balance,** improved form. Beam is 6¾ ins. long, and swings on very delicate knife edges. The column is adjustable as to height. One of the pans is provided with a hook, from which objects to be weighed in liquids may be suspended. The balance is also provided with a beam arrest. An accurate, sensitive, and convenient balance at a low price . $2.50



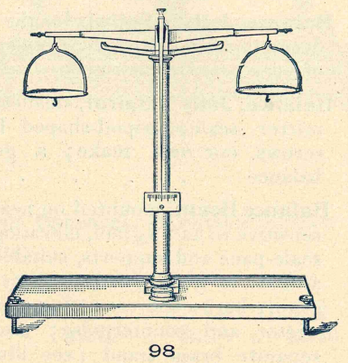
95



97

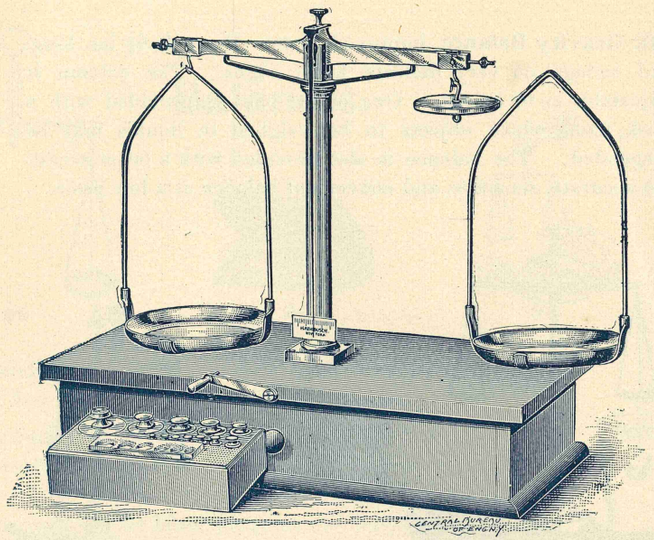
96. **Specific Gravity Balance,** similar to last, but provided with short, interchangeable wire pan-holder, 10 in. beam, and improved raising apparatus on heavy metal base. This balance will serve for ordinary physical and chemical weighings, and with a good load is sensitive to ¼ grain 8.00

97. **Specific Gravity Balance,** constructed after the plan of Dr. Mohr, for solid and liquid bodies, complete 18.00

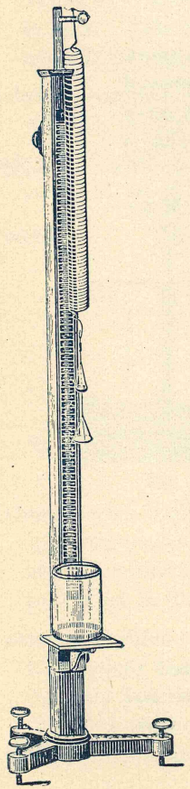


98

98. **Specific Gravity Balance,** made entirely of brass, lacquered to prevent tarnishing; mounted on wood base with screw feet and spirit level. Has 13 in. beam with adjusting screws on ends. Stand 14 ins. high. Sensitive to ¼ grain 16.00



99



100

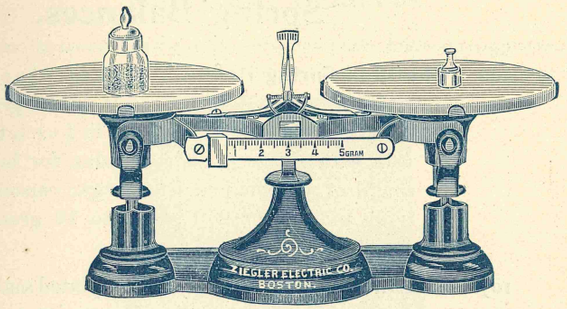
No. Price.

99. **Specific Gravity Balance,** new form, mounted on polished hard-wood box, with drawer for holding weights; capacity 1 kilogram to 1 centigram. Balance is provided with counterpoise scale pan so that it can be used for ordinary physical and chemical weighing. Has 10 in. beam with adjusting screws on ends, and improved raising apparatus. With each balance is included a full set of accurately adjusted weights, 500 grams to 1 centigram, (fractions of 1 gram under glass), and a pair of tweezers. Very fine $25.00

100. **Balance, Jolly's Spiral,** for the rapid and accurate determination of specific gravity of minerals, etc., of very best German make 16.00

101. **Balance, Jolly's Spiral,** smaller than No. 100, with mirror scale; tripod-shaped base with leveling screws, our own make; a good and accurate balance 7.00

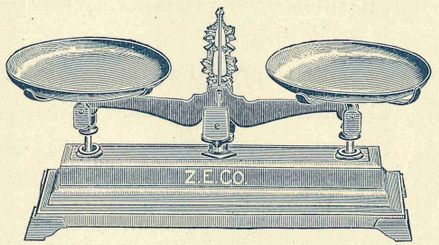
102. **Balance Beam,** mounted on neat box, with drawer, sensitive to half a grain, elevating attachment; brass scale-pans and supports, suitable for nice weighing, and set of weights from twenty grams to a centigram; baroscope consisting of a brass globe, connector, and counterpoise; also the same with a separate brass stand (see illustration, page 43), which may be placed under a receiver of an air-pump to show the buoyant power of air; counterpoise, with hook, for suspension of specimens in finding specific gravity; very desirable, and all complete for 8.00



103

No. Price.

103. **Balance,** platform trip, generally known as the Harvard Balance. As a scale for elementary experiments in physics and chemistry, and general laboratory use, we know of none better. It has 6 in. round flat, porcelain plates, upright indicator, side scale for fine weighing; capacity, 2 kilograms to 1 decigram . . . $5.65

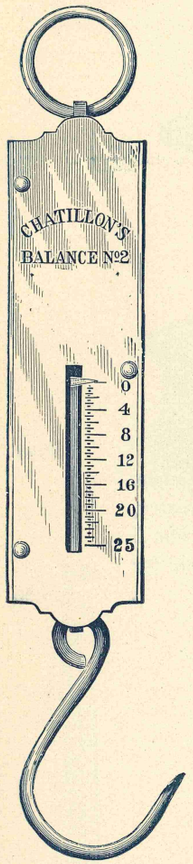


104

104. **Robervahl Platform Balances,** of reliable French manufacture, for coarse weighing,—

Up to . . .	½	1	2	5 kilos.
Diameter of Pans,	4¾	5	5¾	7¾ ins.
	$2.50	$2.75	$3.40	$4.25

105. **Balance,** plain, platform, tin scoop; including set of iron weights, 1 lb. down to ½ oz. 1.75



111

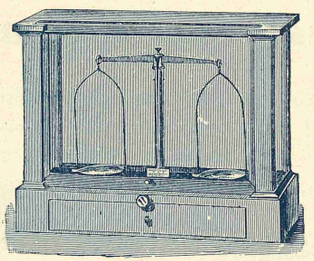
Spring Balances.

No.		Price.
106.	**Chatillon Spring Balance,** nickel-plated scales, graduated on one side in 10 gram intervals, and on the other side in ¼ oz. intervals, with single hook and index for horizontal or perpendicular readings; capacity, 8 ozs. to ¼ oz., or 250 grams to 10 grams; single	$ .55
107.	**Chatillon Spring Balance,** nickel-plated scales, graduated on one side in 25 gram intervals, and on the other side in 1 oz. intervals, with single hook and index for horizontal or perpendicular readings; capacity, 64 ozs. to 1 oz., or 2,000 grams to 25 grams; single .	.25
108.	**Chatillon Spring Balance,** graduated on one side in 100 gram intervals, and on the other in ¼ lb. intervals, with single hook and index for horizontal or perpendicular readings; capacity, 30 lbs. to ¼ lb., or 15 kilos to 100 grams; single	1.25
109.	**Chatillon Spring Balance,** 30 lbs., in quarters, single	1.00
110.	**Chatillon Spring Balance,** 48 lbs., single .	.25
111.	**Chatillon Spring Balance,** 25 lbs., per pair .	.25
112.	**Chatillon Spring Balance,** 4 lbs., with ounce divisions, nickel-plated scale; single . .	.25

N. B. — Send thirty cents for our little Note Book of Tables, Diagrams, and Useful Information. See page 24.

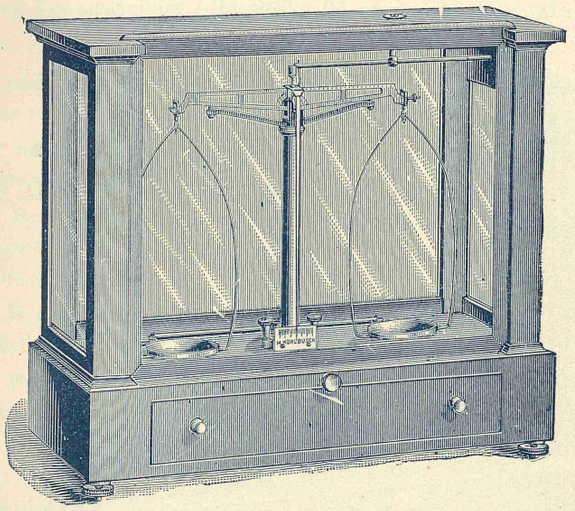
Analytical Balances.

(Our balances are made by workmen of the highest reputation.)



113

No.		Price.
113.	**Balance,** in polished mahogany case; counterpoised door sliding upward; pans of solid nickel, improved raising apparatus, adjusting screws on the beam, sensitive to $\frac{1}{50}$ grain . . .	$20.50



114

114.	**Analytical Balance,** capacity 100 grams in each pan, in handsome case, sensitive to ¼ milligram with its full charge. All bearings agate. Arrest for beam and pans with arrangement for riders and specific gravity. Diameter of pans, 3 in.	50.00

No. 115.

New Aluminum Short Beam Analytical Balance.

For a charge up to 100 grams in each pan, sensitive to $\frac{1}{10}$ milligram. The same has agate knife and agate bearings. Rider has clean sweep across, and can be used from 0 to both ends of beam, which is graduated in $\frac{1}{10}$ milligram. Space between bows 4 in. *Entire scale is heavily plated with Platinum, and is proof against corrosion.*

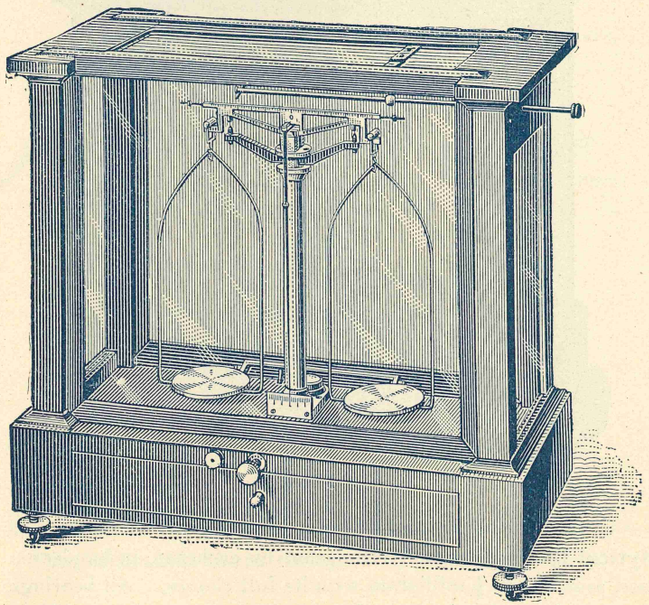
Furnished with apparatus for specific gravity, and metal stand with counterpoise for weighing tubes.

No latch is put on the pan-arrest to keep same down; the sudden jar caused by releasing the latch injures the knives.

On the scale above the push-button is slightly turned to hold the pan-arrest down, enabling the operator to free his hand.

We claim that this scale is superior to many of the cheap analytical balances on the market.

Balance is furnished with a set of accurately adjusted analytical weights, *heavily plated with platinum*, from 50 grams to 1 milligram, and three riders.

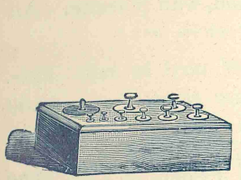


115

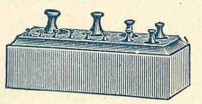
Price complete with weights as described $80.00

Weights.

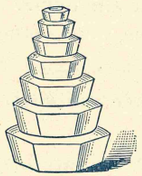
Metric Weights.



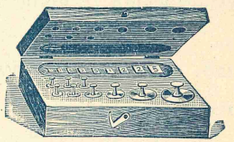
116



119



126



128

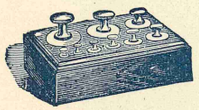
No.		Price.
116.	**Set of neat Brass Weights,** in polished hard-wood block, 20 grams to 1 centigram	$ .55
117.	**Set of neat Brass Weights,** in polished hard-wood block, 50 grams to 1 centigram	.75
118.	**Set of neat Brass Weights,** in polished hard-wood block, 100 grams to 1 centigram	1.25
119.	**Set of neat Brass Weights,** in polished hard-wood block, 500 grams to 1 gram	2.00
120.	**Set of neat Brass Weights,** in polished hard-wood block, 1 kilogram to 1 gram	3.50
121.	**Set of Brass Block Weights,** in velvet-lined mahogany case, adjusted to the utmost accuracy; large weights of solid brass and lacquered, small ones of aluminum; 20 grams to 1 centigram	3.25
122.	**Set of Brass Block Weights** (same as No. 121), 50 grams to 1 centigram	5.00
123.	**Set of Brass Block Weights** (same as No. 121), 100 grams to 1 centigram	6.00
124.	**Set of Brass Block Weights** (same as No. 121), 500 grams to 1 gram	10.00
125.	**Set of Brass Block Weights** (same as No. 121), 1 kilogram to 1 gram	12.00
126.	**Set of Iron Weights,** carefully adjusted, 1 kilogram down to 5 grams	1.10
127.	**Set of Iron Weights,** carefully adjusted, 2 kilograms down to 5 grams	1.75

Weights of Precision, either Gram or Grain, for Analytical Purposes.

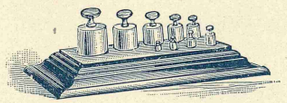
In French polished boxes, lined with velvet, each piece fitted separately, brass weights lacquered. The fractions of the gram are platinum, except below 20 milligrams, which are made of aluminum. Very accurately adjusted, with pincette. All riders weigh 12 milligrams, unless otherwise ordered.

No.		Price.
128.	Platinum gram piece and down to $\frac{1}{10}$ milligram . . .	$8.50
129.	One 10 „ „ „ „ $\frac{1}{10}$ „ . . .	9.00
130.	One 10 „ „ „ „ 1 „ and 3 riders .	9.00
131.	One 20 „ „ „ „ 1 „ „ „ .	10.50
132.	Two 20 „ „ „ „ 1 „ „ „ .	12.00
133.	One 50 „ „ „ „ 1 „ „ „ .	14.00
134.	One 100 „ „ „ „ 1 „ „ „ .	16.00
135.	One 200 „ „ „ „ 1 „ „ „ .	20.00
136.	One 500 „ „ „ „ 1 „ „ „ .	25.00
137.	One kilo „ „ „ „ 1 „ „ „ .	32.00
138.	One platinum 10 grain piece „ $\frac{1}{100}$ grain . . .	9.00
139.	One „ 1000 „ „ $\frac{1}{100}$ „ 3 riders . .	14.00

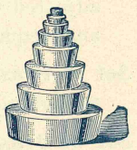
Avoirdupois Weights.



140



143

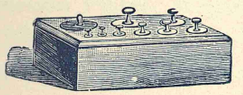


146

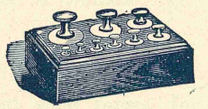
140.	**Set of Brass Block Weights,** 1 lb. to $\frac{1}{8}$ oz.	2.25
141.	**Set of Brass Block Weights,** 2 „ „	3.50
142.	**Set of Brass Block Weights,** 4 „ „	5.00
143.	**Set of Nickel-Plated Brass Weights,** in highly polished ebony block; weights set in recesses on top of block, 1 lb. to $\frac{1}{4}$ oz. .	5.50
144.	**Set of Nickel-Plated Brass Weights** (same as No. 143), 2 lbs. to $\frac{1}{4}$ oz.	7.00

No.		Price.
145.	**Set of Nickel-Plated Brass Weights** (same as No. 143), 4 lbs. to $\frac{1}{4}$ oz.	$9.00
146.	**Set of Iron Weights,** 8 oz., 4 oz., 2 oz., and two 1 oz., making a total of 16 ozs. No weight is in error more than 1 grain .	.60
147.	**Set of Iron Weights,** accurately adjusted and well finished; 1 lb. down to $\frac{1}{2}$ oz.	1.00
	2 lbs. down to $\frac{1}{2}$ oz.	1.50
	4 lbs. down to $\frac{1}{2}$ oz.	2.50
148.	**Set of Iron Weights,** japanned, with hooks accurately adjusted (same as used in Law of Moments Apparatus, see No. 241), 16 oz., 8 oz., 4 oz., two 2 oz., and 1 oz.	1.00
149.	**Set of Heavy Iron Weights,** round, with rings, sealed, great convenience in a physical laboratory; consists of 1 of 16 lbs., 1 of 8 lbs., 1 of 4 lbs., 2 of 2 lbs., and 1 of 1 lb. (the largest is exactly adapted to experiments with seven-in-one apparatus) .	3.50

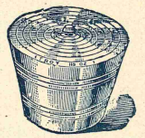
Troy Weights.



150



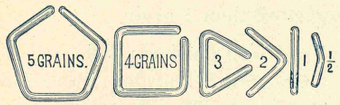
154



157

150.	**Set of Brass Weights,** in cherry block, 1 oz. to $\frac{1}{2}$ grain . .	1.00
151.	**Set of Brass Weights,** „ „ „ 2 „ „ „ . .	1.75
152.	**Set of Brass Weights,** „ „ „ 3 „ „ „ . .	2.50
153.	**Set of Brass Weights,** „ „ „ 10 „ „ „ . .	4.00
154.	**Set of Highly Finished Brass Weights,** in oiled walnut blocks, lined with poplar, 20 ozs. to $\frac{1}{2}$ grain	7.00
155.	**Set of Highly Finished Brass Weights** (same as No. 154), 30 ozs. to $\frac{1}{2}$ grain	9.00
156.	**Set of Highly Finished Brass Weights** (same as No. 154), 50 ozs. to $\frac{1}{2}$ grain	12.50
157.	**Set of Brass Cup Weights,** 4 ozs. and down	1.50
158.	**Set of Brass Cup Weights,** 8 „ „ „	3.00
159.	**Set of Brass Cup Weights,** 16 „ „ „	4.00
160.	**Set of Brass Cup Weights,** 32 „ „ „	5.50

Aluminum Grain Weights.



161

162

No.		Price.
161.	**Set of Aluminum Weights,** wire, from ½ to 5 grains . . .	$ .25
162.	**Set of Aluminum Weights,** of pure sheet aluminum, made concave so they can be picked up readily, ½ to 10 grains . .	.40

N. B.

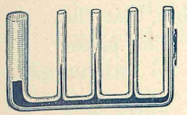
We have prepared for the convenience of teachers, students, electrical workers, and others, a little pamphlet or Note Book of Tables, Diagrams, and Useful Information.

This includes writing tables, resistance tables, formulæ involving π, values of g, specific-heat capacities, diagrams of connections of motors, rheostats, and bridges, telephones and the like.

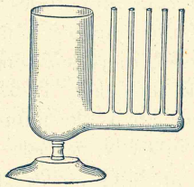
This will be sent to any address, postage paid, on receipt of 30 cents.

General Properties of Matter.

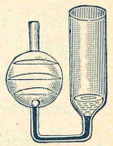
Molecular Forces.



171.



172.



174.

No.		Price.
163.	**Adhesion Disc,** of glass, 3 ins. diameter, ground edge, with silk cord in center	$ .30
164.	**Adhesion Disc,** of glass, with three silk cords from edge . .	.60
165.	**Cohesion Plates,** of glass, 3 ins. in diameter, ground faces and edges, pair	.50
166.	**Cohesion Hemispheres,** of lead, pair	.40
167.	**Cohesion Figures,** five different wire forms, for immersion in solution of soap or Plateau's mixture of glycerine, with large glass jar	2.25
168.	**Capillary Plates,** 3 ins. x 4 ins., with ground edges, pair . .	.35
169.	**Capillary Tubes,** straight, set of four	.10
170.	**Capillary Tubes,** straight, set of four sealed into a bar to rest on a tumbler	.30
171.	**Capillary Tubes,** set of five glass tubes in one piece . . .	.60
172.	**Capillary Tubes,** set of five with vase on foot, large . . .	1.25
173.	**Pair of U-shaped tubes** with one large arm, to show capillary action; the small arm is backed with white bone glass .	.40
174.	**Tubulated Glass Bulb,** 2½ ins. in diameter and glass cylinder 7 x 1½ ins., connected together by a tube of ¼ in. bore; for essays on capillarity	1.00
175.	**Diffusion of Liquids Apparatus,** consisting of a tall glass cylinder on foot and a long glass funnel tube	.65
176.	**Earthen cup** for showing the transfusibility of hydrogen or illuminating gas through porous partitions, ready for use . .	.40

Geometric Forms.

No. Price.

177. **Geometrical Solids,** set of twelve, including three and six-sided prisms, cylinders, cone, pyramid, frustums of cone and pyramid, sphere, hemisphere, oblate and prolate spheroids; made in fine wood, in box $1.10

178. **Cone, Sphere, and Cylinder.** Actual demonstration shows that the contents of the cone three times filled with water fills the cylinder, and that if the cylinder is filled with water and the ball entirely immersed, there will remain in the cylinder just water enough to fill the cone. It follows, therefore, that the contents of the three are as the numbers 1, 2, 3. The pieces are packed together in a box, per set 1.00

179. **Cube Root Blocks,** set of eight pieces of mahogany, illustrating the extraction of square and cube roots, in box . . . 1.10

180. **Dissected Cone,** illustrating conic sections, viz., circle, ellipse, parabola, and hyperbola, of selected wood and of good size . 2.25

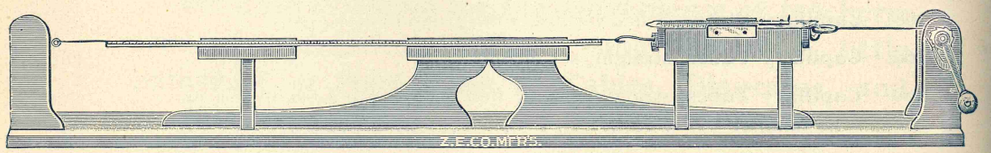
181. **Dissected Cone,** smaller, well made of maple wood . . . 1.75

182. **Models of Crystals,** of thin glass, of 2 to 3 ins. diameter, with thread axes, each 1.10

183. **Models of Crystals,** in wood, thirteen pieces. 2.00

184. **Models of Crystals,** of solid glass, thirteen pieces accurately ground and polished 15.00

Breaking Strength of a Wire.



185

The apparatus shown in above illustration is offered as the best and most complete outfit for testing the breaking strength of a wire ever produced. The spring balance employed is our No. 108. This is fitted with an extra index which does not fly back when wire breaks, thus permitting correct readings to be taken. The breaking of the wire is effected by means of a crank which is supplied with a ratchet to prevent slipping.

The method of attaching the wire is clearly shown in above illustration. All woodwork is made from selected oak.

185. **Apparatus** complete, as described, including spring balance and meter stick (the latter is graduated on one side in both Metric and English divisions), but not including wire . . . 8.00

No. Price.

186. **Apparatus** same as last, only balance is not provided with extra index $7.00

187. **Apparatus** same as No. 185, but without spring balance No. 108. 6.75
(For prices of bare wire of different kinds, see page 204. See also No. 939.)

188. **Apparatus** for testing the breaking strength of a wire (see Ex. 1, page 7, "Hall & Bergen's Physics"); consisting of the following articles: one spring balance No. 108, one metal balance spool for the protection of the wire in its contact with the balance hook, one metal fastening spool for holding one end of the wire when under strain and one guard block, to prevent recoil of the hook of the balance when wire breaks; not including wire . 1.85

189. **Apparatus** for testing the breaking strength of a wire (see Ex. 22, Gage's "Physical Laboratory Manual") without balance or weights 75

Elasticity: Stretching.

190. **Apparatus** for studying the elasticity of stretching of brass wire (see Ex. II., p. 11, "Hall & Bergen's Physics"); consisting of the same apparatus as described under No. 188, and including two meter sticks with metal tips, No. 63, and a cradle for supporting the spring balance in a horizontal position . . 2.45

191. **Cradle** alone for last 30

(For prices of Cross Section Paper, see page 9.)

Elasticity: Bending.

(See Exercise III., page 18, "Hall & Bergen's Physics.")

192. **White Pine Rod,** of selected stock, 41 x ½ x 1 in. 08

192a. **White Pine Rod,** „ „ „ 41 x ½ x ½ in. 06

193. **Prisms,** or supports of cherry, each 08

NOTE:—Two prisms are needed for each pine rod.

194. **Indicator** of light wood 05

195. **Pan** for suspension of weights 10

196. **Weights** will be found under their proper headings.

Elasticity: Torsion.

(See Ex. IV., page 22, "Hall & Bergen's Physics.")

197. **Maple Rod,** selected stock, 36 x ½ x ½ in. 08

198. **Maple Rod,** „ „ 36 x ¾ x ¾ in. 08

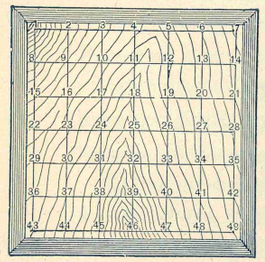
199. **Circular Board,** 12 in. diameter, for ¾ x ¾ in. rod 25

200. **Cardboard,** on which a circle is lithographed, divided into degrees .25

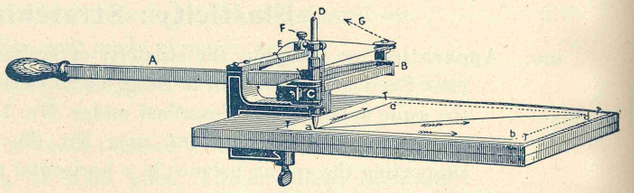
(For Spring Balance, see page 18.)

Dynamics of Solids.

Composition and Resolution of Forces and Velocities.



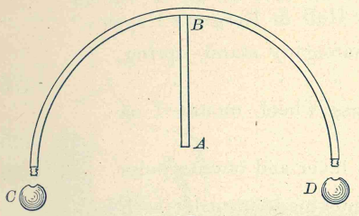
201



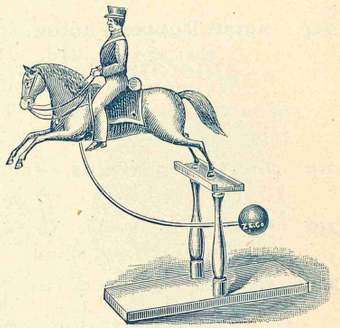
204

No.		Price.
201.	**Hard-wood Board,** 12 x 12 ins., arranged with holes accurately laid by a die at the corners of squares, for balancing different combinations of forces on a plane. Included with each board are four pegs, to which the spring balances are connected (see "Hall & Bergen's Physics," Ex. XIV., p. 92)	$ .85
202.	**Glass Marbles** for use with last, per set	.10
203.	**Hardened Steel Bicycle Balls,** carefully turned and preferable to glass balls, for use with No. 201, per set	.75
204.	**Apparatus** for illustration of composition of forces and velocities (see Gage's "Principles of Physics," p. 17). Each of the components and their resultant are graphically represented by the lines (*ab*, *ac*, and *ad*) drawn by the moving body itself. No pupil seeing it operate can fail to be impressed with the reality of the "composition," etc.	4.50

Center of Gravity.



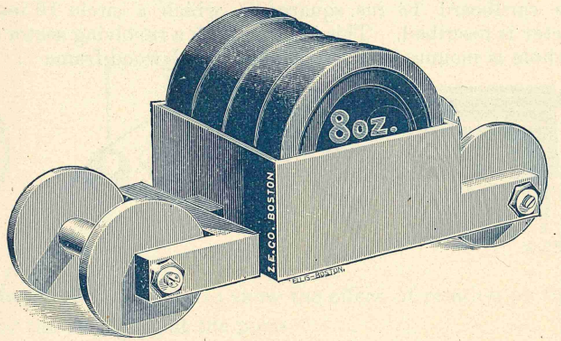
205



208

No.		Price.
205.	**Metal Arc** with balls to illustrate different states of equilibrium, etc.	$ .60
206.	**Witch,** opaque glass bottle loaded so that it will rest only when in an erect position	.15
207.	**Loaded Circular Board and Spindle** for illustrating centers of gravity, magnitude, and motion, and three kinds of equilibrium (see Gage's "Physical Laboratory Manual")	.80
208.	**Balanced Horseman,** illustrating stable equilibrium	1.00
209.	**Safety Valve Weights,** about 4 lbs., spherical shape, with convenient loop or handle, for Ex. XVII., "Hall and Bergen's Physics," each	.20
210.	**Safety Valve Weights,** about 8 lbs., of same description as last, each	.40
211.	**Leaning Tower,** painted wood	1.25
212.	**Feather and Guinea Tube,** with heavy iron base, 4 ft. long .	7.00

Motion.



213.

213.	**Improved Carriage for Inclined Plane** (see Ex. XVIII., p. 131, "Hall & Bergen's Physics"), nicely constructed of metal, has low center of gravity, trucks which run true and with little friction on conical steel bearings, an excellent substitute for the cumbersome wooden carriage, with roller skate trucks, each	1.25

No. Price.

214. **Small Rubber Tubing,** specially vulcanized and pure, for use with carriage No. 213. Per foot . . . . . $ .06

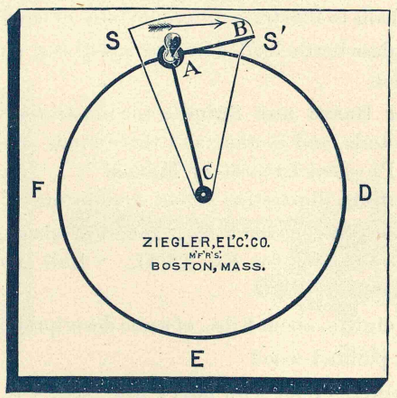
We recommend this tubing to give better satisfaction than the strips of rubber formerly used. Two carriages and six feet in all of rubber tubing are required for Ex. XVIII., p. 131, "Hall & Bergen's Physics."

215. **Inertia Apparatus,** simple form, with mahogany stand, spring, card, and ball 75

216. **Gyroscope,** simple form, with $2\frac{1}{2}$ in. brass wheel, mounted on steel pivot and stand 2.25

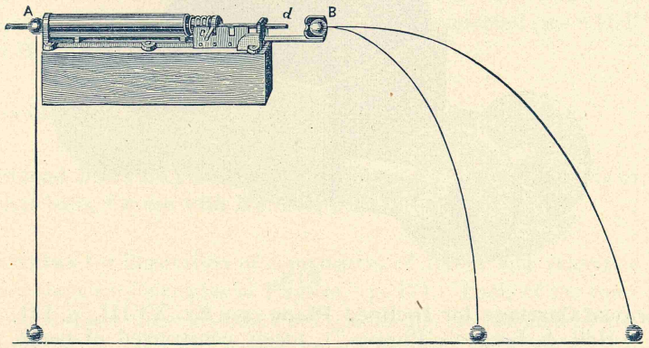
217. **Gyroscope,** same as last, but provided with lever and counterpoise 4.50

Special Gyroscopes of all sizes and kinds made to order with the greatest accuracy.



218

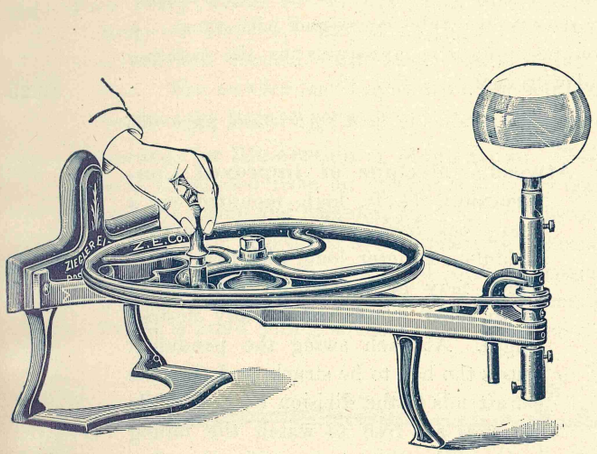
218. **Apparatus** for illustration of Curvilinear Motion (see Gage's "Principles of Physics," page 24), consisting of a stout piece of white cardboard 13 ins. square on which a circle 10 ins. in diameter is inscribed. This is fitted with a revolving sector and the whole is mounted on a substantial hard-wood frame . . . 1.50



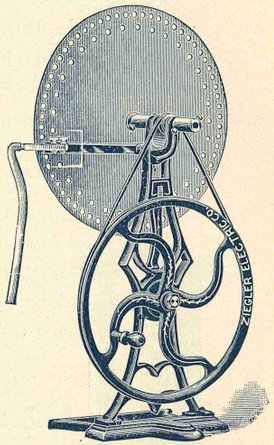
219

219. **Apparatus** to illustrate the second law of motion; the best contrivance yet produced for demonstrating this law . . . 2.00

Improved Rotating Apparatus and Attachments.



220



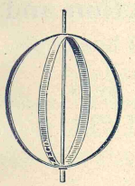
221

220, 224, 225

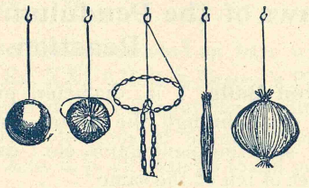
No. Price.

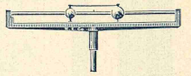
220. **Rotating Apparatus,** very fine, is constructed of iron and brass in the best and strongest manner, and as the illustrations show, can be used to produce rotation in either horizontal or vertical plane, and is adapted to rotating color discs, siren plates, brass rings, etc. $5.00

221. **Glass Globe,** filled with colored liquid, with brass cap and connecting rod for attaching to above machine 75



222





223

222. **Double Elastic Brass Ring,** to show the effect of rotation on the earth, by the flattening at the poles 2.00

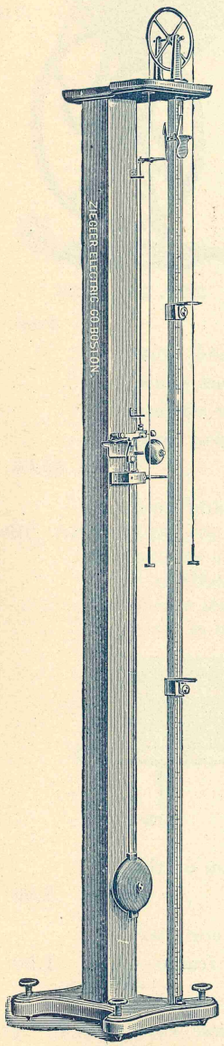
223. **Two Metal Balls,** of unequal size, connected by rubber cord and sliding on a wire, the whole mounted in neat japanned frame . 1.50

224. **Siren Disc of Metal,** with two rows of holes; the outer row has twice as many holes, but of the same size as the inner row, giving two different notes 1.25

No. Price.

225. Attachment, for use with siren disc, consisting of a square brass tube with two brass stop-cocks and support, so arranged that one or two different notes can be sounded at one time by blowing strongly through a rubber tube connected with same. A binding clamp for fastening the apparatus to the rotating machine is included with each $2.25

(See also attachment for producing heat by friction, page 66)



226

226. Atwood's Machine of Improved Construction, 7½ ft. high, mounted on a heavy oak base, with levelling screws; pendulum 1 meter long, with heavy bob, which may be moved on the rod so as to make pendulum of any desired length. At each swing the pendulum causes the bell to be struck, and thus the ear attends to the division of time while the eyes are free to watch the falling body. Simultaneously with the first stroke of the bell, the pendulum, by means of a mechanical device, drops the stage which supports the body which is intended to fall. The machine is finely finished, and we recommend it as the best inexpensive apparatus ever offered in this country 20.00

Atwood Machines of any description made to order. Prices given on application.

Laws of the Pendulum: Action and Reaction.

227. Iron Balls, 1 in. diameter, pierced by a hole through the center, used for constructing pendulums, etc.; each . . .12

228. Set of ten of the same 1.00

229. Solid Glass Balls or Marbles, ⅝ in. diameter, for use in constructing pendulums; per doz. 40

230. Solid Lead Balls or Bullets, ⅝ in. diameter; per doz. 25

231. Solid Brass Balls, carefully turned, drilled, and finished, ½ in. diameter; each . . .12

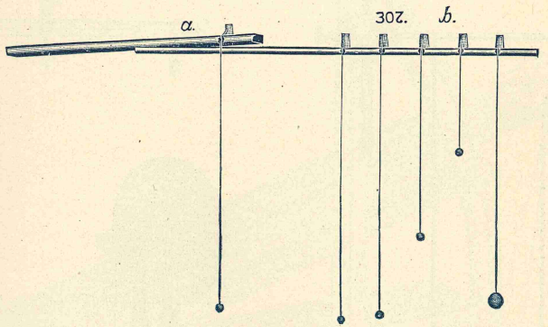
232. Solid Soft-wood Balls, carefully turned, drilled, and finished, 1¼ ins. diameter; each .15

No. Price.

233. Solid Hard-wood Balls, carefully turned, drilled, and finished, 1¼ ins. diameter; each . . . . . $ .35

234. Two Ivory Balls, for illustration of momentum (see "Hall & Bergen's Physics," Ex. XX., page 146), carefully turned, drilled, and finished. The larger ball is about 2 ins. in diameter. The smaller one weighs about one-third or one-fourth as much as the larger; per pair 3.00

235. Apparatus for Illustration of Momentum. Two highly elastic balls, suspended from an upright mahogany frame; large ball contains spring and hammer, small ball weighs one-half as much as large ball. Spring is held in place by a thread, which in the experiment is burned. An equal force is expended on each of the balls, which are thrown distances proportional to their mass. Frame is fitted with graduated arc. Complete as described . 7.00

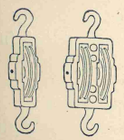


307. Two Systems of Pendulums, with supports (*a* and *b*), nicely constructed and ready for use (see Hall's "Elementary Lessons in Physics," Chap. VI.) 1.00

236. Sight and Release Blocks mounted on base with scale to show reaction, for Ex. XX., "Hall & Bergen's Physics" . . 1.25

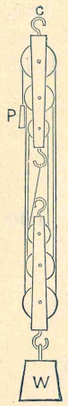
Prices and descriptions of Sand Pendulums for illustrating the composition of simple harmonic motions of different periods (see Gage's "Principles of Physics," Exp. 2, p. 30) will be found on page 58.

Simple Machines.


237. 238.

237. Single Brass Pulleys with Hooks; wheels 1⅝ in. diameter, nicely balanced. Well-made pulleys in every respect, each 75

238. Double Brass Pulleys with Hooks; wheels 1⅝ in. diameter, nicely balanced. Well-made pulleys in every respect, each 1.25

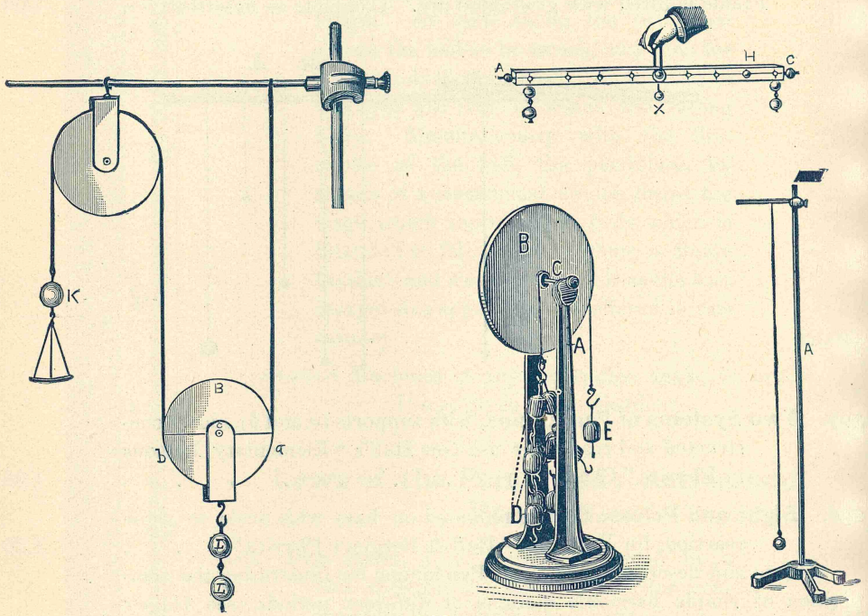


239.

No. Price.

239. Set of Three Brass Pulleys and Hooks, of different diameters for forming different combinations, as shown in illustration, per set of three, without weights . . $1.50

Set of weights No. 242 is admirably adapted for use with these sets of pulleys.

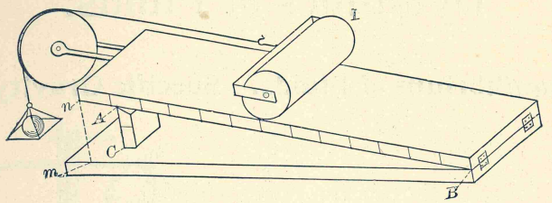


240.

240. Mechanical Powers Apparatus, including pulleys, levers of all kinds, wheel and axle, and devices for illustrating fully the principle of a balance beam. The tall, upright iron stand with attached clamp (see above illustration) forms an excellent support for pendulums. Complete 5.50

241. Rod with Hooks, pulley and set of weights (16 oz., 8 oz., 4 oz., two 2 oz., and 1 oz.), suited to verifying the law of moments (see Gage's "Laboratory Manual," p. 35) 1.60

242. Weights alone 1.00

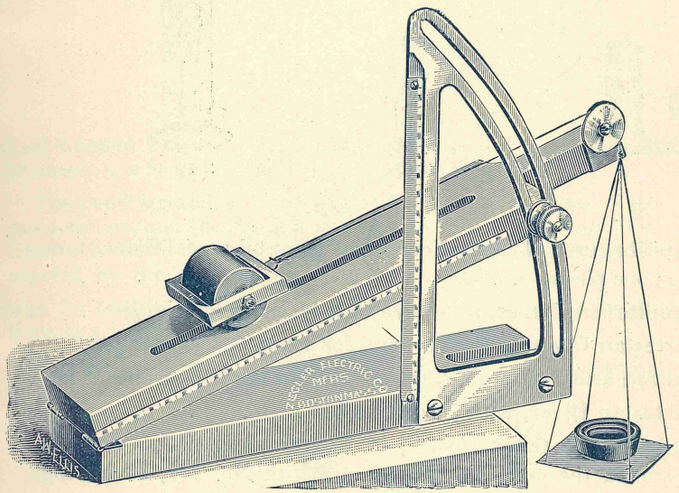


243.

No. Price.

243. Inclined Plane (see Gage's "Laboratory Manual," Ex. 80, page 46), including 9 lb. iron roller, sleigh, etc., but without weights . $3.25

(For weights suitable for use with above apparatus, see No. 149.)

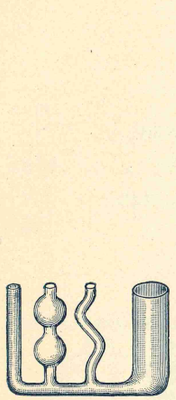

244

244. Adjustable Inclined Plane, shown about one-third actual size in cut. The roller is made of brass and accurately turned. It weighs with its frame just 16 ozs. The scale is graduated into millimeters. Great care has been exercised in making this piece. Without weights 4.25

N. B. — Send thirty cents for our little Note Book of Tables, Diagrams, and Useful Information. See page 24.

Dynamics of Fluids.

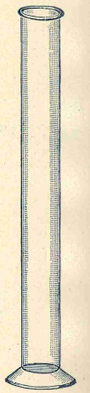
Equilibrium of Fluids. Specific Gravity.



245

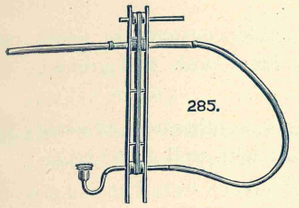
248

249

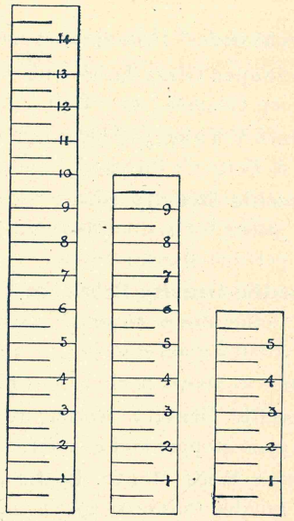


250

No.		Price.
245.	**Equilibrium Tubes,** four connected glass tubes of different forms in one piece	$ .70
246.	**Equilibrium Tubes,** set of five with vase and foot, large . .	1.35
247.	**Cartesian Diver or Bottle Imp,** for use in hydrometer jar . .	.25
248.	**Balloon and Car** of glass, with figure, for use in hydrometer jar .	.75
249.	**Cartesian Diver,** with jar and rubber	.75
250.	**Cylinders of Glass,** footed, of best German make, with ring around the neck, suitable for use with No. 248, 13 ins. high and 2 ins. in diameter; each	.50
251.	**Upward Pressure Apparatus.** Glass cylinder ground to fit brass plate, the latter having a cord attached to its center; without glass jar or supporting frame	1.00
252.	**Upward Pressure Apparatus,** same as last, but with glass jar and brass frame for firmly supporting cylinder in an upright and vertical position	2.00
253a.	**Jar** with rubber bottom, to show downward pressure of the atmosphere	1.00
254.	**Woulff Bottle,** capacity 500 cubic centimeters (see Ex. 30, page 31, "Hall & Bergen's Physics"), with two necks, one with perforated antimony rubber stopper and glass rod; the other with perforated antimony rubber stopper, and glass tube drawn small at one end to deliver a jet	1.00



285.



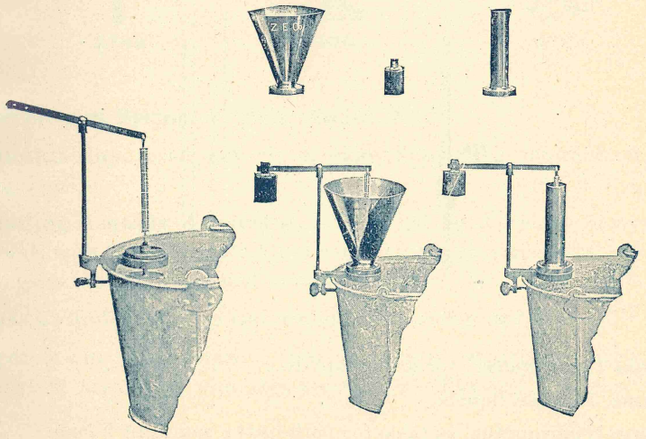
254a

No.		Price.
254a.	**Set of Loaded Prisms.** Gage's apparatus to demonstrate that *pressure in a body of liquid is proportional to depth* . . .	$1.00

The pupil ascertains the weight of each prism, the area of its cross-section, and the depth it sinks in the liquid, and computes from this data the upward pressure per square centimeter exerted by the liquid upon each of the floating prisms.

285.	**Gauge** for testing pressure at various points and in various directions in a jar of water	1.00

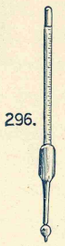
For price of lamp chimney and cork, used with pressure gauge, see Miscellaneous Apparatus, page 219.



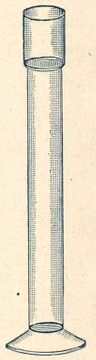
256a

256a.	**Pascal's Vases,** to show that pressure of liquids is independent of quantity of liquid, shape of vessel, etc.	3.50

No.		Price.
257a.	**Archimedes' Principle,** cylinder and bucket of brass, well made	$1.00
258.	**U-Shaped Glass Tube,** with arms 50 centimeters long, for balancing columns (see "Hall & Bergen's Physics," page 60)	.25
259a.	**Glass Y-Tube,** with attached rubber and glass tubes (see "Hall & Bergen's Physics," page 61)	.45
260a.	**Specific Gravity Bottle,** capacity 25 cubic centimeters, unadjusted for self-adjustment, very light, fitted with well-ground, perforated glass stopper	.30
261a.	**Specific Gravity Bottle,** capacity, 25 cubic centimeters, adjusted to the utmost accuracy, very light, fitted with well-ground, perforated glass stopper	.85
262a.	Same as above, in tin case, with counterpoise	1.35
263a.	**Specific Gravity Bottle,** 100 cubic centimeters, with ground glass stopper and counterpoise	2.25
264a.	**Extra Wide Mouth Bottles,** 2 oz. capacity, with glass stopper suitable for use as specific gravity bottles, per doz.	.84
265a.	**Demonstration Hydrometer.** (The study of the hydrometer should commence with this)	.20
266a.	**Demonstration Hydrometer,** of wood, graduated into millimeters (see Exp. 14, page 52, "Hall & Bergen's Physics"), so constructed that it will sink 1 centimeter in water if a 1 gram weight is placed upon it, therefore displacing 1 cubic centimeter of water	.20



258

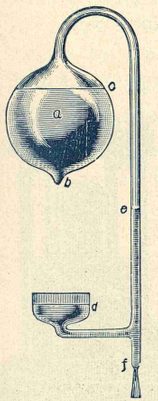

270a

295.	**Glass Hydrometer,** for heavy liquids	1.00
296.	**Same,** for light liquids	1.00
267a.	**Glass Hydrometer,** suitable for both heavy and light liquids	1.50
268a.	**Nicolson's Hydrometer,** of brass	3.25
269a.	**Glass Jar,** for floating last in	.50

No.		Price.
270a.	**Pair of Narrow Glass Jars,** with broad bases, 14 ins. deep, answer for siphon experiments, hydrometer jars, and many other purposes	$1.00
271a.	**Conical-Shaped Glass,** graduated in cubic centimeters, capacity 100 cc.	.60
272a.	**Package** of choice specimens of twenty different substances, including antimony and six other metals, selected for finding specific gravity	.25
273a.	**Bottle,** 2 liter capacity, for use in finding specific gravity of air (see Ex. XI., "Hall & Bergen's Physics"), fitted with rubber stopper and glass connection for pump	.40

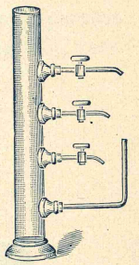
(For balances and weights for specific gravity work, see each under that heading.)

Liquids in Motion.

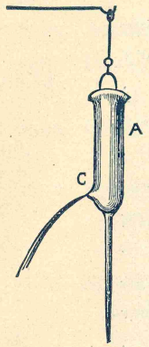


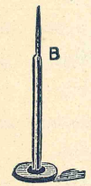
274a

275a


276a

274a.	**Intermittent Spring,** all glass, without stand	1.25
275a.	**Tantalus Cup,** made entirely of glass, illustrating intermittent springs	.60
276a.	**Spouting Liquids Apparatus,** cylinder 20 by 3 ins., on heavy base, with four apertures fitted with three glass stop-cocks, and a glass tube which is bent at right angles	5.00
277a.	**Glass Cylinder,** same as last, without stop-cocks and tubes	2.50
278a.	**Eight-in-one Apparatus.** (For the eight experiments that may be performed with this, see Gage's "Physical Technics," pages 8-11)	5.50
279a.	**Glass Siphon,** plain	.25
280a.	**Glass Siphon,** with suction tube	.40





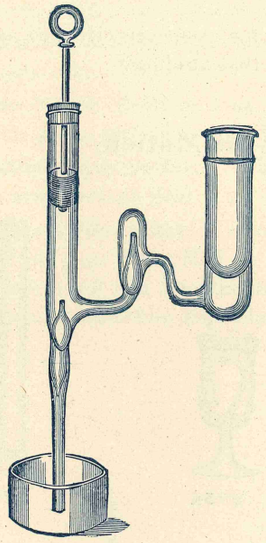
281a

Reaction Apparatus (German).

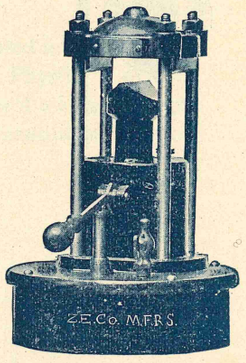
"To every action there is a reaction."

No. | Price.

281a. Reaction of Liquids. Suspend the apparatus by a strong thread 2 ft. long; place beneath the glass point a pointed wire, so that one shall be directly over the other. Fill the bucket with water, and the action of the stream will be attended by a reaction of the glass, as shown by the separation of the points . . . . . $ .60



282a



283a

282a. Hydraulic Press, glass working model 1.50

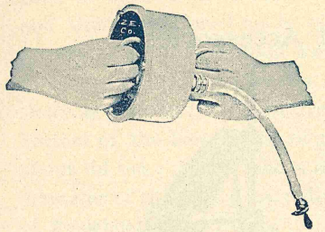
283a. Hydraulic Press, improved working model, for breaking bars of iron or wood; mounted on a very strong iron frame, with force pump and brass stop-cock, and made in the most thorough manner throughout. Lard oil or sperm oil is recommended as preferable to water for use in iron cistern. Very powerful . 25.00

284a. Cast-Iron Bars, 1 in. thick, suitable for breaking with last, each .10

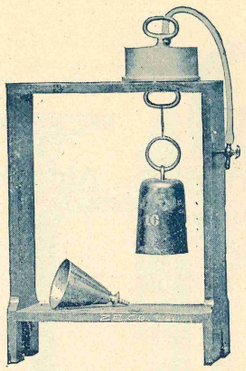
286a. Hydraulic Ram, glass model on hard-wood base . . . 3.50

287a. Archimedes' Pump of metal with cistern 5.00

288a. Model of Water Wheels, representing overshot, undershot, and breast, of japanned metal 8.00



289a



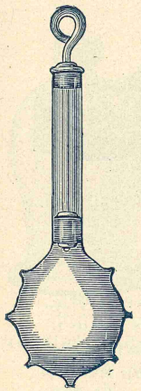
289a-290a

No. | Price.

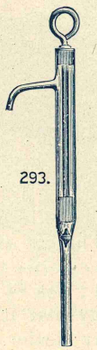
289a. Seven-in-One Apparatus, fulfilling the offices of the Magdeburg hemispheres, weight-lifter, hydrostatic and pneumatic bellows, etc., with rubber tube 12 ft. long, hard-rubber stop-cock, connector to connect with air pump, and brass funnel; without stand or weights $6.50

290a. Hard-wood Stand for Seven-in-One Apparatus, very convenient 2.20

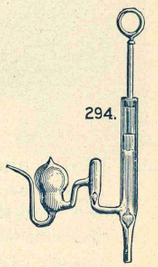
291a. Block with attached platform for use with Seven-in-One Apparatus (see Gage's "Introduction to Physical Science," Fig. 37), very convenient 1.00



292a



293



294

292a. Transmission of pressure in all directions. Fill with water and force the piston in, and horizontal streams will be thrown to equal distances in all directions 1.50

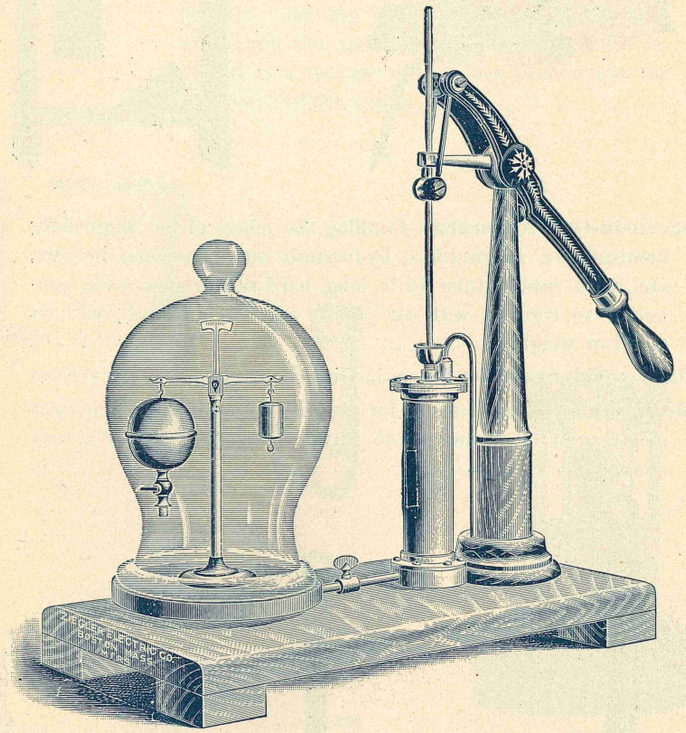
293. Glass Model of Lifting Pump, well made and of good size . 1.25

294. Glass Model of Force Pump, of improved form and well made 1.25

295a. Glass U-Tube to show the principle of hydrostatic press (see Gage's "Introduction to Physical Science," Fig. 44, page 48) . .25

Pneumatics.

Air Pumps and Accessories.



296a 299a

No. Price.

296a. Air Pump and Receiver. The cut shows our improved form, as well as some of the accessories to No. 102. It is made in the most thorough manner; has 8½ in. plate, metal valves, and we can conscientiously say that it is the best pump for the money ever offered by any dealer. Price, including 2 gal. Bell Glass Receiver, No. 301a $23.00
Without receiver 21.00

297a. Air Pump, same as No. 296a, fitted for "Electric Bell in Vacuum," including 2 gal. Bell Glass Receiver, without Electric Bell or Battery 25.00

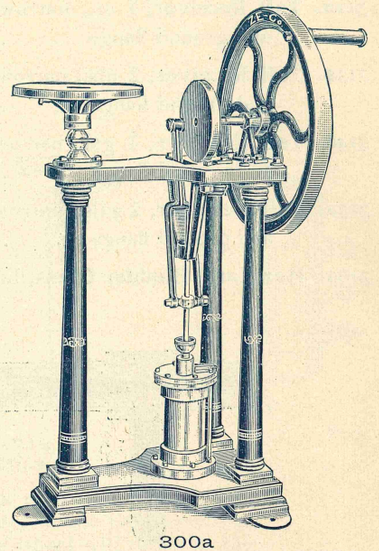
298a. Electric Bell and Battery for use with No. 297a . . . 2.50

299a. Brass Baroscope and weight (see illustration above) for use in showing air has weight, also that bodies weigh less in air than in a vacuum; without brass stand and scale beam . . 4.50

No. Price.

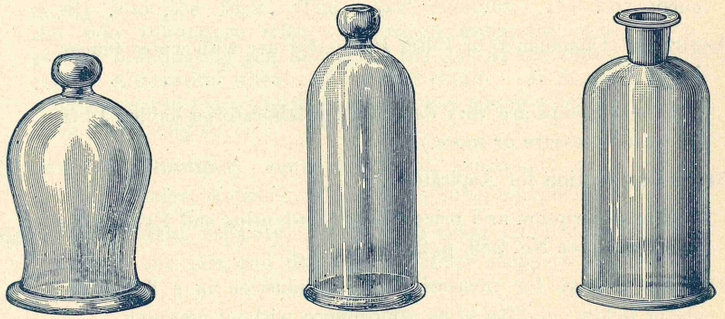
300a. Our Improved Type of Rotary Air Pump, shown in opposite illustration, is offered as a very efficient and thoroughly well-made piece of apparatus capable of good work and at a low price. We give its dimensions as follows: Height from the bottom of the base to top of plate is about 44 ins.; width about 33 ins.; diameter of plate, 13¼ ins.; diameter of fly-wheel about 24 ins.

The plate is made of brass and is ground perfectly flat. The base is made of polished mahogany and is fitted with heavy metal corner pieces for fastening the pump firmly to the floor. The face of the fly-wheel is purposely made flat, so that it may be run by power or by hand, whichever may be preferred, $150.00



300a

Bell Glasses.



301a 303a 311a

301a. Swelled Receiver, 2 gals., with knob and ground flange. This size and shaped receiver is recommended for use with our air pump, No. 296a 2.00

302a. Swelled Receiver, 3 gals. with knob and ground flange . . 3.00

303a. Tall Receiver, 1 pt., with knob and ground flange 30

304a. Tall Receiver, 1 qt., „ „ „ „ „ 40

305a. Tall Receiver, 2 qts., „ „ „ „ „ 60

306a. Tall Receiver, 1 gal., „ „ „ „ „ 85

308a. Tall Receiver, 2 gals., „ „ „ „ „ . . . 1.50

309a. Tall Receiver, 3 gals., „ „ „ „ „ . . . 3.00

310a. Tall Receiver, 5 gals., „ „ „ „ „ . . . 5.00

311a. Open Receivers, tall, not stoppered, wide opening or narrow neck; same sizes and prices as given above for Tall Receivers with knob.

No. Price.

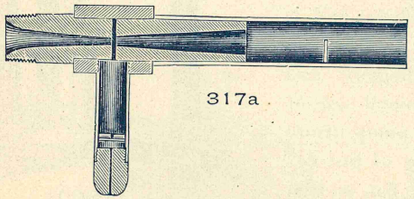
312a. Tall Receiver, 1 qt., narrow neck, with ground-in glass stopper and ground flange . . . . . $ .75

313a. Tall Receiver, 2 qts., narrow neck, with ground-in glass stopper and ground flange 1.00

314a. Tall Receiver, 1 gal., narrow neck, with ground-in glass stopper and ground flange 1.40

315a. Tall Receiver, 2 gals., narrow neck, with ground-in glass stopper and ground flange 2.50

316a. Hand and Bladder Glass, both flanges ground 80



317a

319a

317a. Aspirator (Chapman's) or Filter Pump, for use with water faucet, small 1.35

318a. Aspirator (Chapman's) or Filter Pump, for use with water faucet, large 2.25

(These pumps are very desirable for laboratories having 12 ft. of water pressure or more.)

319a. Brass Connection for Aspirator 25

(For description and price of our Condensing and Exhausting Air Pump, see No. 289, p. 217.)

320a. Vacuum Gauge for measuring any exhaustion in a 2 gal. receiver below one-fifth of an atmosphere, without mercury . .80

321a. Vacuum Gauge, same as last, with mercury ready for use; the mercury has been boiled to free it from air and moisture . . 2.00

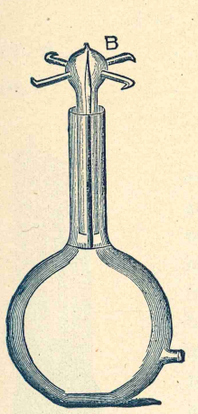
322a. Bottle of Pump Oil and Oiler 25

323a. Leather Washers for Air Pump, each 02

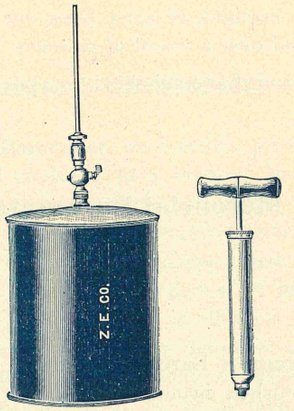
324a. Thin Foot Ball with key, for use under our 2 gal. Swelled Receiver, No. 301a, to show the expansive power of air . . .85

325. Glass Tube with bulb to show expansive power of air (see Gage's "Introduction to Physical Science," Exp. 36, page 39) . . .15

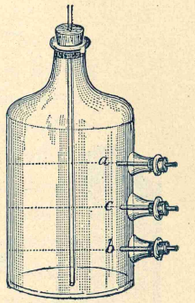
326. Bolognese Flasks for breaking, showing condition of unannealed glass, each 12



327



328



329

No. Price.

327. Reaction Gas-Wheel. (See above illustration.)

(1) Pour a little water into the neck of the flask. Stopper the side tubulature, place the apparatus under the receiver of an air pump, and exhaust the air. The wheel will rotate as the air in the flask expands and passes up through the central tube, and through a side orifice, and subsequently through the lateral tubes. (2) Attach a rubber tube to the side tubulature, and blow gently into the flask. The wheel revolves. (3) Connect the side tubulature with a hydrogen generator or service-pipe of illuminating gas, and ignite the gas at the ends of the arms. A beautiful wheel of light will result. (4) Stopper the tubulature, and place the flask a little way above a flame. You have a heat-engine $2.00

328. Condensing Chamber, very substantial, japanned; with condensing syringe, stopcock, and delivery tube, complete . . 6.00

329. Mariotte's Bottle, capacity, 1 gal., with three equidistant tubulatures on one side, and fitted with rubber stoppers and glass tubes, each 3.75

330

330. Mariotte's or Boyle's Law Tube, well made of even bore, bent and closed, ready for use 85

331. Mariotte's or Boyle's Law Apparatus; hard-wood, upright support, fitted with well-made tube and measuring stick; the latter graduated on its face in both English and Metric divisions. Complete 1.85

(For prices of extra long Mariotte's Tube, see No. 290, p. 217.)

No.		Price.
332.	**Barometer Tube,** straight, of even bore, one end closed, to be filled and inverted over a vessel of mercury	$ .45
333.	**Mercury,** cleaned and double distilled, per pound . . .	.80

Mercurial Barometers.

334

334. Mercurial Barometer, neatly mounted in polished mahogany case, with white-enamelled glass scale, graduated on one side of the tube in millimeters and on the other side in inches, with pointer . . 6.00

335. Mercurial Barometer, similar to last, but more cheaply mounted, and supplied with pasteboard scale 4.00

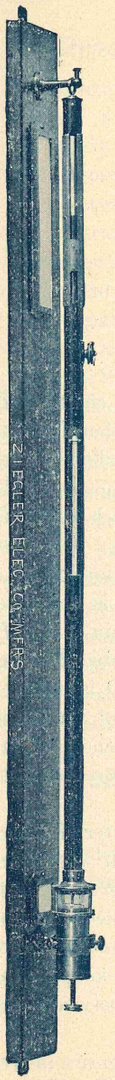
336. Mercurial Barometer (Hick's make), with attached thermometer and sliding vernier, mounted in neat polished oak case; has celluloid scale of very wide range, graduated on one side of the tube in millimeters and on the other side in inches.

This barometer is supplied with a screw (shown in above illustration) for making adjustments of the mercury level in the cistern. The tube is of large caliber, so that there is no danger of the mercury column sticking against the interior of the tube. In this form of barometer the end of the column tube will always remain covered with mercury, so that air cannot get into the column. A reliable barometer at a low price 8.00

337. Mercurial Barometer (Hick's make), same as last but provided with silvered metal scale instead of celluloid . . 10.00

336

Standard Barometer.



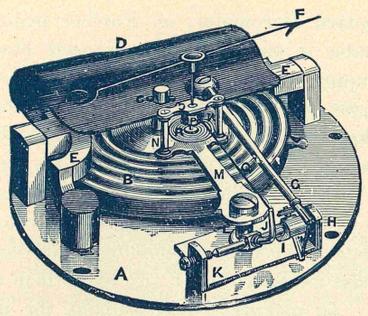
338

Standard Barometer, on Fortin's principle. The mercury tube is enclosed in a bronzed brass body, having at its upper end two vertical openings in which the vernier works, the latter operated by rack movement. The readings are taken through these openings, aided by light reflected from a white opaque glass reflector let into the mahogany board behind. The scale is divided on one side into inches and twentieths, and on the other to centimeters and millimeters, the vernier enabling a reading to be taken, in each case respectively, of $\frac{1}{500}$ of an inch and $\frac{1}{10}$ of a millimeter. In making the instrument, the mercury is boiled in the tube, to insure the complete exclusion of air and moisture, while Fortin's cistern insures a constant level from whence to take the readings. A highly sensitive thermometer, with scale engine divided on stem, is attached to the brass mounting, which is perforated to admit the attenuated bulb of the thermometer into absolute contract with the glass tube of the barometer, to insure its indicating the same temperature as the contained mercury.

The instrument is suspended by a ring from a brass bracket attached to a mahogany board, and the lower end passes through a larger ring having three screws for its true vertical adjustment.

No.		Price.
338.	**Standard Barometer,** as above	$42.00
339.	**Standard Barometer,** „ „ with scale reading to $\frac{1}{100}$ of an inch	35.00
340.	**Polished Mahogany or Oak Box,** suitable for Nos. 338 and 339, with lock and key, and provided with iron brackets. Front and sides turn back, disclosing the barometer ready for use. This box is suitable for mounting parallel to a window; being pierced at the back, light is admitted to the opal glass plates, forming a translucent background. Brackets can be changed to the right by simply removing the screws. In ordering, state kind of wood preferred . .	8.50

The Aneroid Barometer.



Construction.

The Aneroid Barometer, as above shown, consists of the vacuum chamber *B*, composed of two disks of corrugated German-Silver firmly soldered together, forming a box, from which the air is exhausted, and to each side of which is attached a brass center — one with a thread on it to screw the chamber to the base plate *A*, the other plain, with a hole drilled across it to receive a knife-edge *C*, which suspends the vacuum chamber from a powerful spring *D*, as seen in the drawing. On these principally depends the action of the instrument. The base or foundation plate *A* is of iron or brass, and circular in form; to this the vacuum chamber is attached, while a strong iron carriage *E*, fixed across the chamber, supports the main-spring *D*, which, acting in direct opposition to the undulations of the vacuum chamber *B*, gives rise to the variations of the needle *F*, on the dial. To the main-spring *D*, is attached the main lever *G*, a compound bar of iron or brass, which compensates for errors arising from changes of temperature. To the end of this lever is attached a small rod of steel, connecting it with the regulator *I*, which is furnished at its center with a vertical arm of brass *J*, by which it communicates with the movement.

The "movement" is furnished with a stout base plate *K*, to the center of which a short brass pillar is screwed, bearing a projecting arm *M*, at the end of which are two smaller brass pillars *N*, supporting a thin plate of brass *O*, and between these and the flat arm moves the arbor *P*, on which is fixed the index. A piece of fine chain *Q*, as used in the works of watches, is attached to and operates about the arbor *P* on the rise or fall of the lever, a fine hair spring of coiled steel *R* keeping the hand in its proper position; the chain *Q* forming the connection between the vertical arm *J* and the arbor *P*.

The connection having been made between these various parts, the entire movement is screwed to the iron foundation plate *A*, and connected with the main lever by means of a fine steel rod at the end; and the communication thus rendered complete between the various parts of the instrument, it is ready for the final adjustment of the dial and hand.

This done, it only remains to graduate the scale, which is effected by placing the instrument under the glass receiver of an air-pump with a Standard Mercurial Barometer attached. The air is then exhausted, and as the mercury falls inch by inch, the Aneroid Scale is pointed off and graduated from 31 ins. to any required range.

Practical Advantages of the Aneroid Barometer.

This instrument, owing to its portable form, great sensitiveness in responding to changes in the pressure of the atmosphere (denoting changes in pressure much more quickly than the mercurial barometer), is to-day in more general use by observers of meteorological changes, than any other form of barometer.

It, however, can never be used as an independent standard; the scale is graduated arbitrarily by a standard mercurial barometer (described under the head of Construction) and should occasionally be compared with a mercurial barometer, and if necessary, adjusted to correspond with the mercurial column; when, however, they are so compared and adjusted, the advantage of this form over the mercurial for general use is evident at once.

To the Surveyor, Miner, and Navigator, as well as the Tourist, it is most valuable. At sea, where the motion of the ship renders a mercurial barometer so unsettled, the Aneroid is indispensable. In measuring altitudes, owing to its portability, sensitiveness, and the ease with which practical results may be obtained, it is highly valuable to the engineer.

The tourist, with Aneroid in hand, notes foot by foot his gain in elevation.

It can be shipped with perfect safety, and carried in any position without danger of derangement; it is not at all liable to get out of order and is not easily broken. Even in observatories where the mercurial standard barometer is used, the Aneroid is found valuable owing to the earlier indication of change denoted in atmospheric pressure than can be obtained from the mercurial barometer.

The best form of Aneroids intended for measuring altitudes are provided with revolving altitude scales which denote the height attained at a glance.

To Measure Altitudes with the Aneroid without the Altitude Scale.

Generally speaking, the fall of 1 in. in the barometer indicates a rise of about 900 ft. in elevation:

917 ft. above sea level the barometer falls 1 in.
1860 ft. above sea level the barometer falls 2 ins.
2830 ft. above sea level the barometer falls 3 ins.
3830 ft. above sea level the barometer falls 4 ins.
4861 ft. above sea level the barometer falls 5 ins.

To Determine the Difference in Height between Two Given Places.

Note the reading of the Aneroid at one of the points of observation, then at the other, subtract the lower reading from the higher and multiply the product by 9,

this will give the difference of altitude in feet. For example, the Aneroid at the base of a hill indicates 29.90 ins., at its summit 30.18 ins.

30.18
29.90

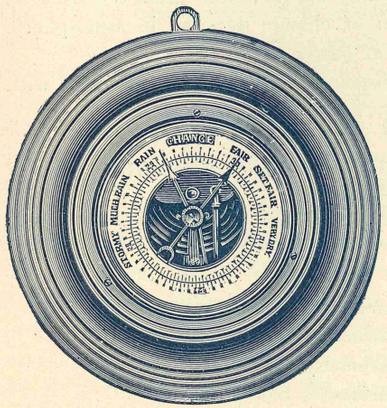
28
9

Height of hill 252 ft.

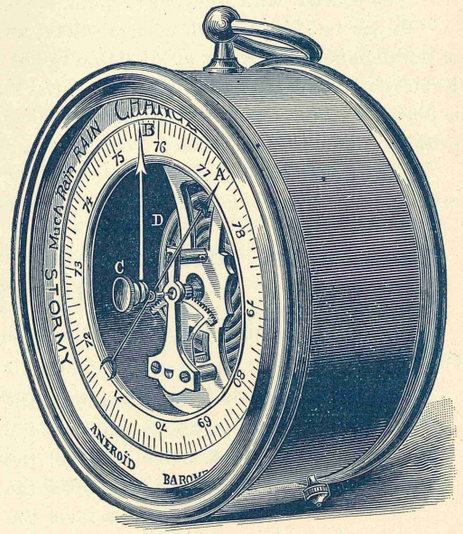
The above method, under ordinary atmospheric pressure, at a temperature of about 50° Fahrenheit, will give good results, but if the temperature be above or below 50°, allowance must be made, and the use of the following table will be found to give results more strictly accurate:

MEAN TEMPERATURE.		30°	40°	50°	60°	70°	80°
Mean Pressure.	27 ins.	9.7	9.9	10.1	10.3	10.5	10.8
	28 ins.	9.3	9.5	9.8	10.0	10.2	10.4
	29 ins.	9.0	9.2	9.4	9.6	9.8	10.0
	30 ins.	8.7	8.9	9.1	9.3	9.5	9.7

Aneroid Barometers.



342



341

No. Price.

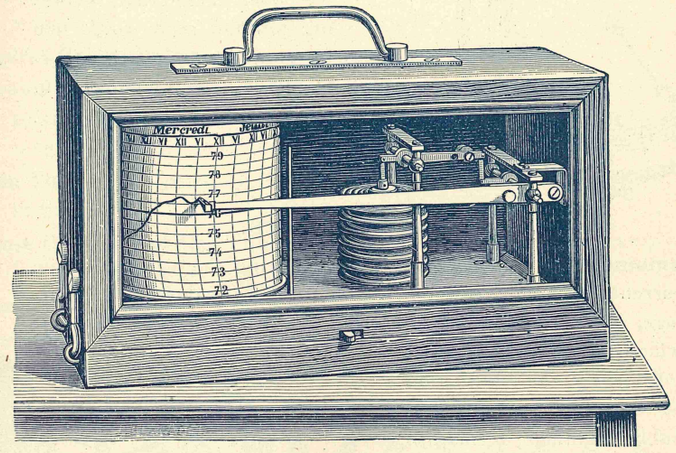
341. **Aneroid Barometer,** mounted in nickel-plated case, with 4 in. glass and open face showing mechanism; will stand upright or may be suspended by attached ring $3.25

342. **Pendant Aneroid Barometer,** with thermometer, mounted in ebonized case, with 4 in. glass and open face showing mechanism 5.75

No. Price.

343. **Pendant Aneroid Barometer,** with thermometer mounted in handsome carved oak case, 4 in. glass and open face showing mechanism. Very ornamental as well as accurate . . . $6.75

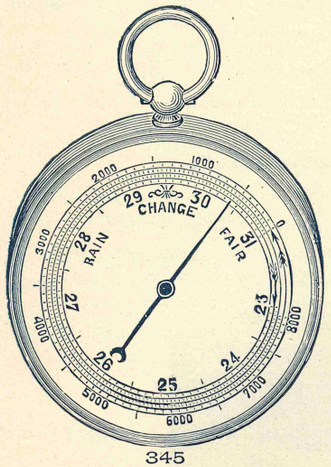
Self-recording Aneroid Barometer.



344

344. This instrument, the latest form of Self-recording Barometer, is remarkable for the simplicity of its construction and the accuracy of its work. It consists of an Aneroid Barometer, composed of a series of vacuum boxes, the movements of which are transmitted through a simple mechanism to a long lever, terminating in a metallic pen which touches a drum, within which is an eight-day clock. This drum, around which is wound the record blank, makes one revolution in seven days, so that each diagram forms a complete barometric record for the week. After winding the clock and setting the Barometer, the instrument requires no attention whatever until the weekly record is finished. The pen retains enough ink to last for several weeks. Has an attached thermometer. In mahogany case, with glass front 45.00

Pocket Mountain Aneroid Barometers.



345

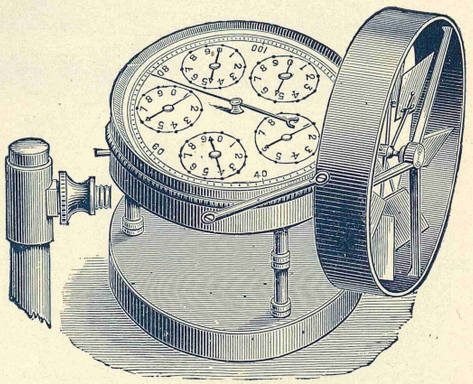
No. Price.

345. **Pocket Aneroid Barometer,** watch size, metal dial, with revolving altitude scale to 8,000 feet $10.00

346. **Pocket Aneroid Barometer,** watch size, metal dial, revolving altitude scale to 15,000 feet, compensated with thermometer and compass in morocco case . . . 15.00

Anemometers.

347. **Anemometer** or Wind Gauge, for measuring the velocity of air currents in mines, sewers, hospitals, public and private buildings, etc. Diameter of fan-wheel, $2\frac{3}{4}$ ins., with disconnector, which is extensively used for testing the ventilation of hospitals, schools, and public buildings; forms also an admirable pocket anemometer for tourists. The indications are obtained by the revolution of a series of fans, acting first upon a long hand capable of recording the velocity of fifty feet per minute on the large dial, divided to one hundred feet, and then successively, by a train of wheels on the indexes of five smaller dials, recording, respectively, 1,000, 10,000, 100,000, and 10,000,000 feet, or 1,894 miles, an amount found to be more than adequate to the most protracted observations. In neat wooden case 23.00


347

348. **Anemometer,** similar to the preceding, with sand-glass running one minute, attached to the stop, rendering observation of the time piece unnecessary. In neat wood case 25.00

Sound.

Undulations, Reënforcement and Interference of Sound Waves.

No. Price.

349. **Rubber Cord,** best suited for illustrating to the eye all kinds of wave-motion and vibrations of strings, 12 ft. long . . . $ .60

350. **Spiral Brass String,** to show wave-motion, 12 ft. long . . 1.75

351. **Crova's Disc,** lithographed, 30 centimeters diameter, fitted for the rotating machine No. 220; including a card with a slit in it the length of the radius of the circle 45

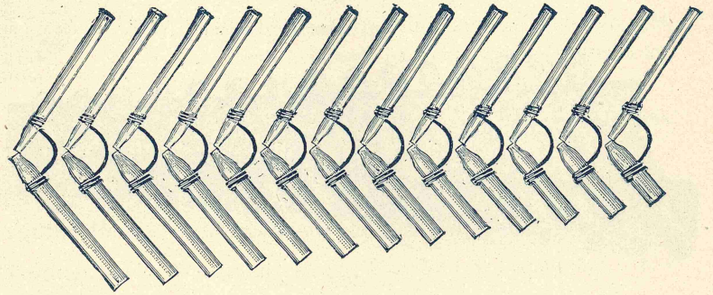
352. **Tin Tube** in five parts, 11 ft. long; for illustrating wave-motions in the air 2.25

353. **Rose Burner and Gas Tube,** used with No. 352, producing very loud sound waves 1.00

354. **Resonance Tube,** of glass, with sliding diaphragm 75

355. **Resonance Jar,** „ „ 15 ins. high, 2 in. diameter, on foot . .50

356. **Interference Tube,** tin, adjustable for use with the Chladni's Plate of No. 378 . . . . . 1.25


357

357. **Acoustic Tubes,** invented by Professor Quinke, of Heidelberg University, and made under his own directions; have gained great celebrity; illustrate effects of different size and length of tube on pitch, also interference of sound, in a most striking manner (by blowing through two tubes at the same time), etc. Set of thirteen tubes 2.00

358. **Nickel-Plated Bicyclist's Whistle** for Exp. 6, page 205, "Principles of Physics," by Gage 35

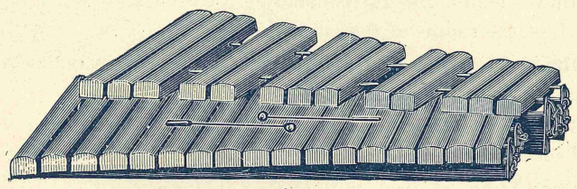
Pitch of Musical Sounds.

No. | Price.

359. **Pitch Pipe** A and C or A and G, extra fine quality, each . . $ .20

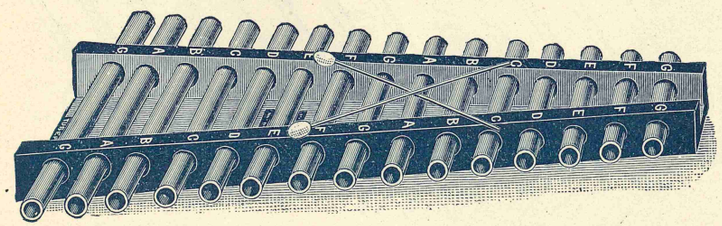
224. **Siren Disc** of Metal (see page 31), with two rows of holes made to fit our rotating machine No. 220; the outer row has twice as many holes, but of the same size as the inner row, giving two different notes 1.25

225. **Attachment** for use with Siren Disc (see page 31), so arranged that one or two different notes can be sounded at one time by blowing strongly through a rubber tube connected with same. A binding clamp for fastening the apparatus to the rotating machine, No. 220, is included with each 2.50



360

360. **Xylophone,** consists of fifteen pieces of wood, sounding two octaves, with two beaters, on chords and frame 1.50

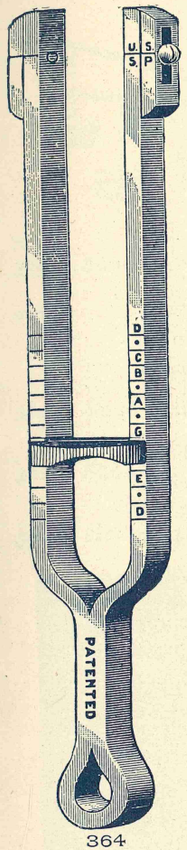


361

361. **Tubephone,** consists of fifteen brass tubes suspended in a finely finished solid wood frame, sounding two octaves, with two beaters; its tone is equal to any set of bells 2.00

362. **Organ Pipe,** glass side, membrane on a frame to lower to show nodes 3.50

363. **Organ Pipe,** with movable piston, giving two octaves, shows the effect of an open and closed pipe 3.50



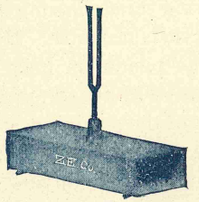
364

Tuning Forks.

No. | Price.

364. **Improved Patent Adjustable Tuning Fork.** United States Standard Pitch, adopted in general convention at the New England Conservatory of Music. Adjustable so as to give any note in the octave; nickel-plated. Direction for using: Gently push open the tines and move the slide to the line below the letter required $1.10

365. **Diapason or Tuning Fork,** middle C, physical scale of polished steel 7½ ins. long, heavy, mounted upon a resonance box, producing 256 double vibrations 2.25



365

369

366. **Tuning Fork,** middle C, physical scale, 256 double vibrations, heavy, of polished steel, 7½ ins. long, unmounted 1.25

367. **Tuning Fork,** middle C, physical scale, 256 double vibrations, very heavy, 9¾ ins. long, of polished steel; very fine 2.75

368. **Tuning Fork,** of polished steel, C^2, physical scale, 512 vibrations, 6 ins. long; very fine 1.00

369. **Tuning Fork,** C natural, small, philharmonic, 538 vibrations . .20

370. **Tuning Fork,** A natural, small, philharmonic, 452.4 vibrations . .20

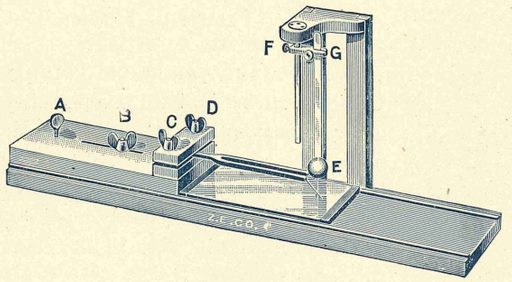
371. **Tuning Fork,** C natural, small, Standard International, 517.3 vibrations 20

372. **Tuning Fork,** A natural, small, Standard International, 435 vibrations 20

373. **Four Tuning Forks,** C^1, E, G, C^2, unmounted, of polished steel, large and heavy; very fine 6.00

374. Same mounted on resonance box 8.00

375. **Eight Diapasons,** of polished steel, giving the octave, unmounted, ranging in length from 6 ins. to 7½ ins.; very fine . . 9.00



376

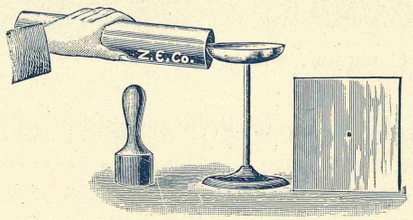
No. Price.

376. **Apparatus** for recording the vibrations of a tuning fork. In the design of this apparatus we have been guided by suggestions of eminent teachers and professors who have used similar forms, as well as by the result of long and careful experiments.

The pendulum is a strip of spring brass having for a bob a large lead cylinder, to which the style is fastened. By loosening binding screw *G* the length of the pendulum may be varied, thus increasing and decreasing at will the rate of vibration of the pendulum. The adjustment of the pendulum style against the glass plate is accomplished by loosening the binding screw *F*, the clamp holding the pendulum sliding up and down on a square brass rod attached to the upright support. The inclination of support for tuning fork may be controlled by turning thumb-screw *A*. By loosening the thumb-nut *B*, which serves to hold the tuning fork support in a firm position, the tuning fork can be moved either backward or forward.

The tuning fork is firmly held in its support by the two thumb-nuts *C* and *D*. The slide for glass plate is fitted to a grooved track, in which it can be quickly drawn beneath the styles in a direction at right angles to the vibrations. Apparatus complete, as described $3.25

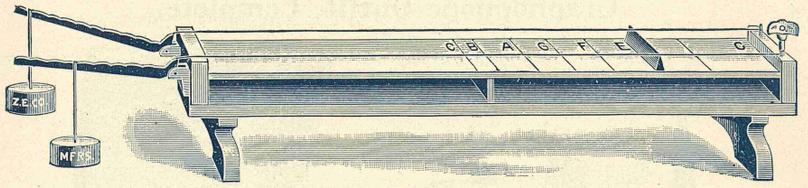
377. **Tuning Fork** with attached style, for use with last, separate . 1.35



378

378. **Chladni's Plate and Savart's Bell,** with adjustable closed tube resonator; also open tube to show that the latter should be twice as long as the former. Complete 4.50

Vibration of Strings.



379

No. Price.

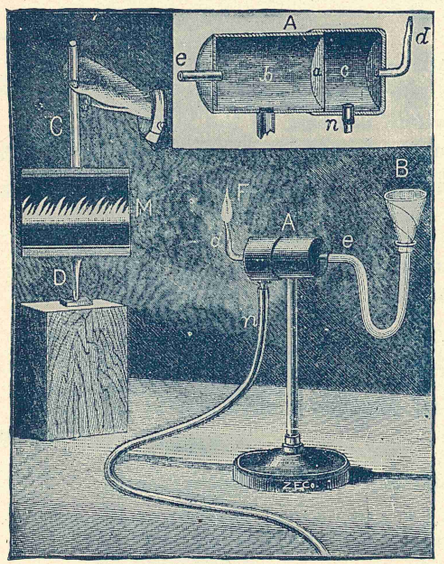
379. **Sonometer,** improved form; of selected wood, levers, and set of weights for varying tension, divisions for harmonics, bridges, two wires, tension keys, etc. $5.00

Analysis and Synthesis of Sound Waves.

380. **Sand Pendulum,** in neat, hard-wood frame, with screw for adjusting length of cord; very satisfactory 3.50

381. **Sand Pendulum,** weight, cord, and funnel, to be used with heavy upright stand and clamp of Dynamics apparatus No. 240 . . .75

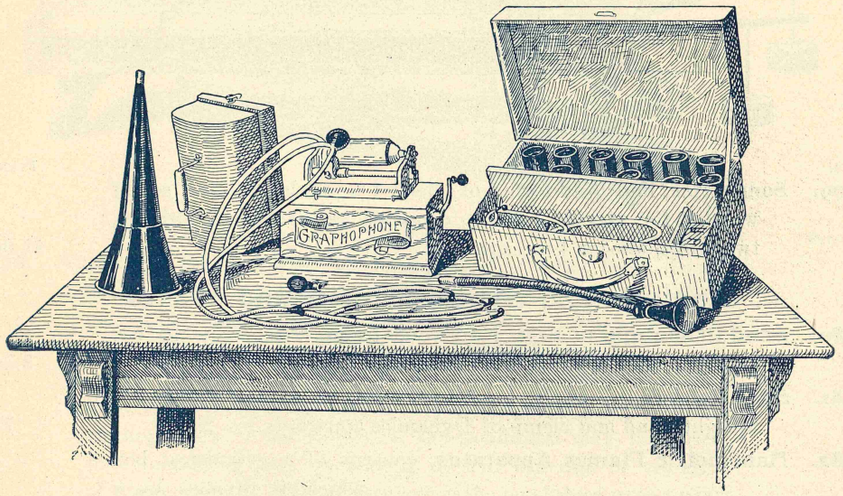
382. **Manometric Flames Apparatus,** consists of a cylindrical box which is divided by a membrane into two compartments; box is mounted on a neat stand; one compartment of box is fitted with rubber tube and porcelain mouthpiece, and the other with tubes for gas connections; revolving mirrors in brass frame fitted with spindle to be revolved by the hand. This apparatus serves to illustrate in a very pleasing manner many facts pertaining to sound vibrations; complete as described . . 2.50



382

383. **Vibration Telephone.** Not electrical. Speaks loudly and clearly. Simple and cheap. In this apparatus a well-known principle of acoustics is practically applied. It consists of a sound box at each end, fitted with a properly insulated wire stretched between them; including 100 ft. insulated wire 1.00

Graphophone Outfit, Complete.



384

No. Price.

384. **Perfected Graphophone,** or Talking Machine. All electricity is dispensed with, the motive power being furnished by an ingenious clock-work motor within the base of the machine. A few turns of the key gives sufficient power to make or reproduce half a dozen records of music, conversation, recitation, or other sounds.

The complete instrument is smaller and lighter than an unabridged dictionary, durable in construction, easily operated, and most attractive in appearance. A marvelous scientific instrument.

Price, including Hand Case and Cover, Speaking Tube, six choice Musical Records, three Blank Cylinders, three Hearing Tubes, Canvas Carrying Case for twelve cylinders and 14 in. Tin Horn $50.00

Further particulars regarding this instrument will be gladly furnished on application.

(See also Telephones and Microphones, each under their proper heading.)

Reflection of Sound Waves.

385. **Pair of Concave Reflectors,** highly polished, nickel-plated, 10 in. diameter, with arrangements for attaching to the rod of a ring stand for support; well suited for illustrating the reflection of sound waves 2.00

No. Price.

386. **Balloons of Collodion,** 16 ins. in diameter, for use in Ex. 166, page 199, "Principles of Physics," by Gage $1.00

387. **Sound Lens,** with stop-cock for the admission of carbonic acid gas, on base; adjustable 13.00

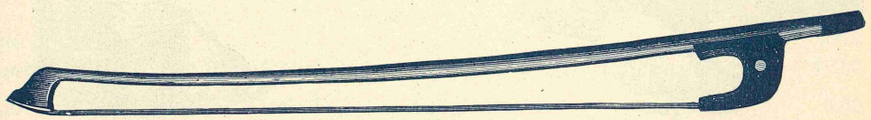
Accessories.

388. **Wires for Sonometer,** per set 20

389. **Spring Brass Wire** for vibration. No. 24 B. & S. gauge wound on spool; ½ pound 30

390. **Piano Wire,** per coil 35

(In ordering wire, give size according to the B. & S. gauge.)

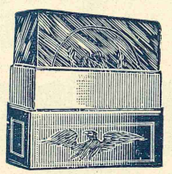


391

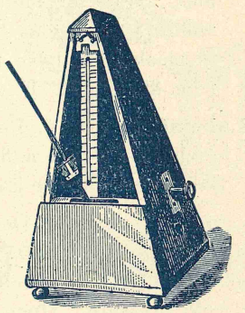
391. **Heavy Double Bass Bow** for use with vibrating plates, bells and tuning forks, etc.; good quality 1.25

392. **Resin,** in box 10

393. **Large Foot Bellow and Rubber Gas Bag Reservoir,** for sounding organ pipes, in an even tone 8.00



392



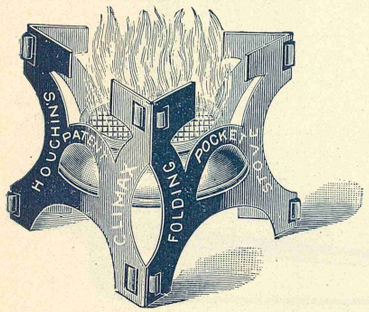
394

394. **Metronome,** for marking time 4.00

395. **Metronome,** with bell 5.50

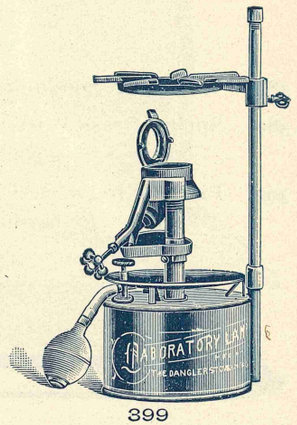
Heat.

Sources of Heat. Specific Heat.



398

396

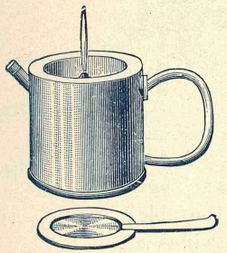


399

No.		Price.
396.	**Alcohol Lamp,** of best German make, ground caps, with wick and wick holder, 2 oz.	$ .30
397.	**Alcohol Lamp,** of best German make, ground caps, with wick and wick holder, 4 oz.	.35
398.	**Alcohol Stove,** with tripod for support of vessels to be heated. These stoves are cheaper, safer, more saving of alcohol, and far better heaters than the ordinary glass alcohol lamp, and cannot fail to supersede the latter in laboratories where gas is not available. Made of metal, packed in boxes, 4½ ins. long, 3¼ ins. wide, 1½ ins. high. Weighs, 5 ozs. With seven teaspoonfuls of alcohol we have raised one pint of water in 12½ minutes from 32° to 212° F.	.20
399.	**Laboratory Lamp,** for gasolene, constructed in a compact form, giving as perfect a flame as a gas burner; very desirable for laboratories where gas is not available	5.00

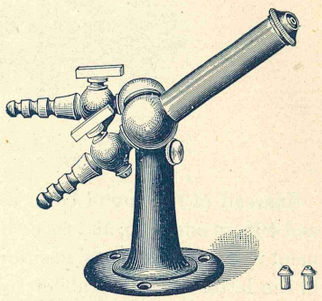
DIRECTIONS: — Use 74° Deodorized Gasolene only. Fill tank two-thirds full and connect bulb to air valve by rubber tube. Force air into tank by using bulb; then close air-valve screw and not depend on bulb to hold pressure. Open burner valve and allow cup to become half filled with fluid; close burner valve and apply match; after contents of cup is nearly burnt out, open burner valve and burner will light at cone. See that there is no leak around air valve by applying lighted match to joints while pressure is on. Will run about two hours with one pumping up, if these directions are properly followed.

Blast Lamps.



400

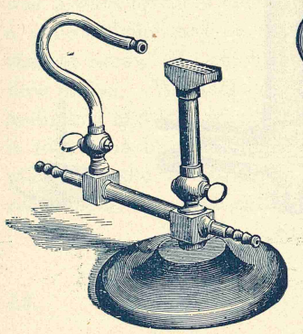
402



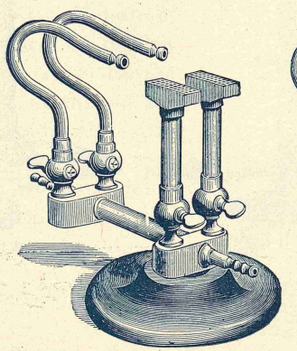
403

No.		Price.
400.	**Blast Lamp for Alcohol,** of heavy copper, upright blast, small size	$2.00
401.	**Blast Lamp for Alcohol,** „ „ „ „ „ large „	3.00
402.	**Blast Lamp for Alcohol,** with safety valve, horizontal blast, made of brass and copper	2.75
403.	**Blast Lamp,** Bunsen's, for gas, superior make; Blast and Supply Pipe in one direction	3.25

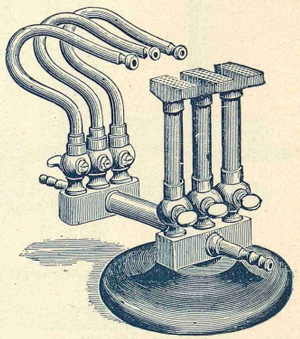
Glass Blowers' Blast Burners.



404

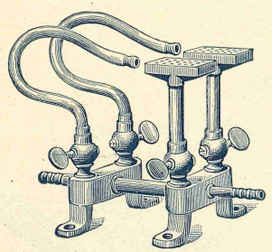


405

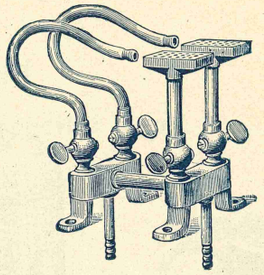


406

404.	**One Light Burner** on round, heavy base	5.00
405.	**Two Light Burner,** „ „ „ „	7.50
406.	**Three Light Burner** „ „ „ „	10.00



407



408

Instead of the round base, we also make them same as Nos. 404, 405, and 406, in one, two, and three light, supply tubes for blast and gas arrangement in either horizontal position, or so that tubes can go through the table; in the latter case, the rubber tubing is not in the way of the glass blower. Prices same as Nos. 404, 405, 406.

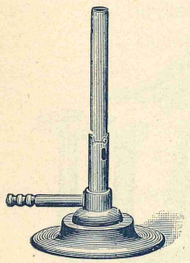
409

410

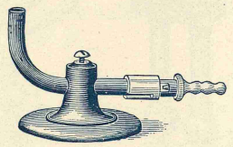
411

No.		Price.
409.	**Tips** for Glass Blowers' Burners, each	$ .45
410.	**Tips** for Glass Blowers' Burners, each	.55
411.	**Tips** for Glass Blowers' Burners, each	.55

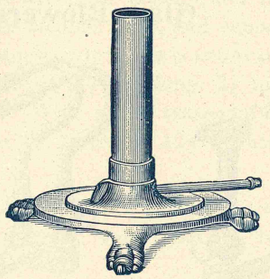
Bunsen Burners.



412



413



414

415

412.	**Bunsen Burner** with flame check (height, 6 ins.). Diameter of the tube, $\frac{7}{16}$ in.	.35
413.	**Bunsen Burner**, low shape (height, 3 ins.). Diameter of tube, $\frac{7}{16}$ in.	.40
414.	**Bunsen Burner** (height, 3 ins.). Diameter of tube, $\frac{3}{8}$ in.	.25
415.	**Bunsen Burner** brass, nickel-plated (height, 2 ins.). Diameter of tube, $\frac{1}{4}$ in.	.40

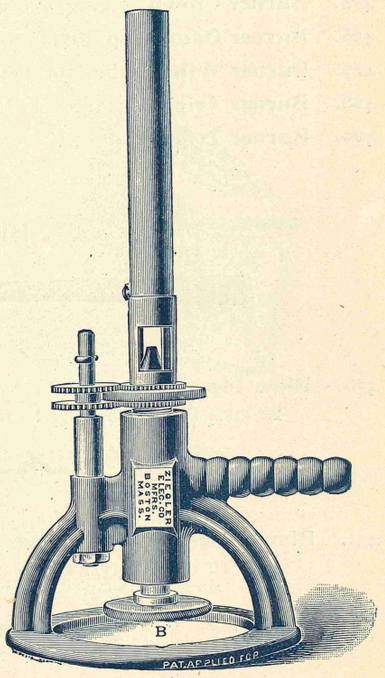
No.		Price.
416.	**Bunsen Burner**, three tubes, with flame checks (height, 6 ins.). Diameter of tubes, $\frac{7}{16}$ in.	$1.20
417.	**Bunsen Burner**, four tubes, with flame checks (height, 6 ins.). Diameter of tubes, $\frac{7}{16}$ in.	1.35
418.	**Bunsen Burner**, new pattern, with flame check, brass stop-cock; a small inner tube permits it being used as a minute burner; nicely constructed and a very desirable laboratory burner, giving an intensely hot flame	1.35
419.	**Burner** to illuminate working table on iron base; fitted with long tube and lava gas tips; stands 12 ins. high	.80
420.	**Burner** (same as No. 419) with separate stop-cock	1.35

Self-adjusting Bunsen Burner.

Patented.

The cut shown illustrates our new Self-adjusting Bunsen Burner. The following are its special features: —

By turning knurled part *A*, you can increase or decrease at will the size of the flame, the flow of gas and air being regulated automatically, and therefore the burner will always retain a blue flame. If desired, a yellow flame may be obtained by turning the set screw *B*, which only regulates the flow of gas. We feel confident that an examination and trial of our burner will prove it to be the best and cheapest burner ever placed on the market, and we can highly recommend it to give entire satisfaction.



421

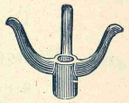
421.	**Self-adjusting Bunsen Burner**, made entirely of brass in the best possible manner, each	1.25
422.	**Self-adjusting Bunsen Burner** (same as No. 421), without set screw *B*	1.10

Bunsen Burner Attachments.

423

424

426

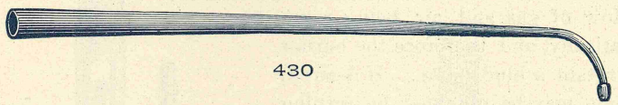

428 and 429

425

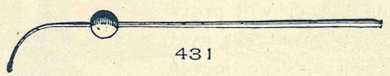
427

No.		Price.
423.	**Burner Tube,** for blow-piping, with yellow flame, fitting inside burner tube	$ .14
424.	**Burner Tube,** with rest for blow pipe	.15
425.	**Burner Crown,** giving a round flame, for heating small dishes	.30
426.	**Burner Gauze Top,** giving a large round flame	.25
427.	**Burner Wing Tube,** for bending glass tubing, etc.	.15
428.	**Burner Tripod** (small)	.15
429.	**Burner Tripod** (large)	.16

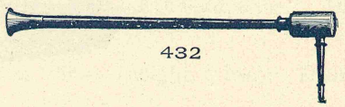
Blow Pipes.


430

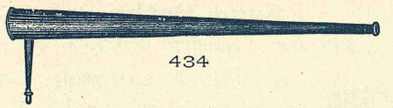
430.	**Blow Pipes,** brass, plain; 8 in., 15 cts.; 9 in., 18 cts.; 10 in., 20 cts.; 11 in., 25 cts.; 12 in.	.30


431

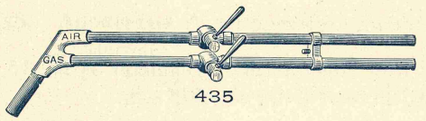
431.	**Blow Pipes,** brass, with air chamber; 8 in., 20 cts.; 9 in., 25 cts.; 10 in., 30 cts.; 12 in.	.35


432

432.	**Blow Pipe,** Plattner's, nickel-plated, with rubber mouthpiece, without platina point	1.75
433.	**Blow Pipe,** Plattner's, nickel-plated, with rubber mouthpiece and platina point	2.25

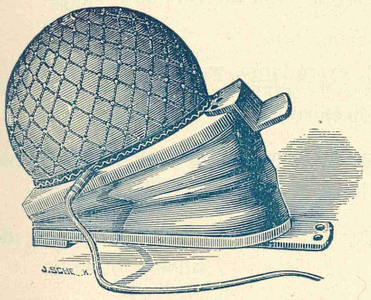

434

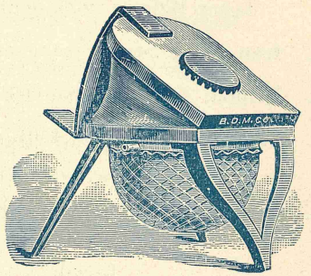
No.		Price.
434.	**Blow Pipe,** Black's conical, of japanned tin, with detachable brass tip	$ .25



435

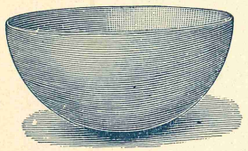
435.	**Blow Pipe** for brazing, two stop-cocks, brass, nickel-plated	3.00
436.	**Blow Pipe** (same as No. 435), one stop-cock, brass, nickel-plated	2.50
437.	**Blow Pipe** (same as No. 435), without stop-cock, „ „ „	2.00


438

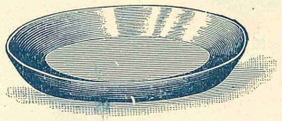

439

438.	**Bellows or Blower,** foot, for steady and powerful blast, medium size	5.00
439.	**Bellows** (same as No. 438), new pattern, on iron legs; medium size	6.00
440.	**Bellows,** hand, for Exp. 110, "Introduction to Physical Science," by Gage	.75
441.	**Gauze,** of iron, 4 ins. square, 5 cts. By the square foot	.35
442.	**Gauze,** of brass, 4 „ „ 8 „ „ „ „ „	.50
443.	**Asbestos Board,** $\frac{1}{16}$ in. thick, cut 4 x 4 ins.	.06
	Asbestos Board, $\frac{1}{16}$ in. thick, cut 5 x 5 „	.08
	Asbestos Board, $\frac{1}{16}$ in. thick, cut 6 x 6 „	.10
444.	**Asbestos Paper,** thin, per sheet	.10

Sand Baths.



445



446

No. | Price.

445. **Sand Bath** of iron (deep form). Diameter 3½ in., 15 cts.; 4 in., 20 cts.; 5 in., 25 cts.; 6 in., 30 cts.; 8 in. . . . . $ .60

446. **Sand Bath** of Russia iron (shallow form). Diameter 3 in., 10 cts.; 3½ in., 15 cts.; 4 in., 20 cts.; 5 in., 25 cts.; 6 in. 30

447. **Sand Bath** of tin (shallow form). Diameter 5 in. 05

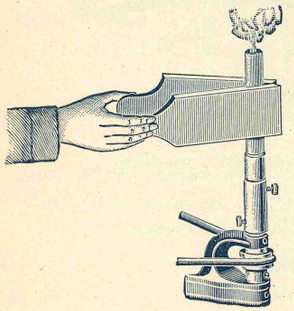
448. **Iron Ring Stand** with three rings, rings being provided with improved screws which can be taken out from the side and will fasten tight to thick or thin rod 75

449. **Iron Ring Stand** (same as No. 448), extra large, with four rings 1.00

450. **Tripod**, small, of iron, circular top, for spirit lamps 20

451. **Tripod** (same as No. 450), of iron, for Bunsen Burners, with two rings 35

452. **Tripod**, of iron, heavier, without rings 30

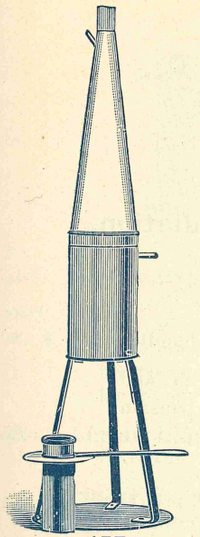


454

453. **Fire Syringe,** brass cylinder and piston, with box of tinder, for exhibiting the evolution of heat by the rapid compression of air . 1.75

454. **Tyndall's Apparatus,** for boiling water by heat of friction, cylinder of copper, with friction clamp. This apparatus is fitted to attach to our rotating machine, No. 220 3.00

455. **Specific Heat Apparatus,** Tyndall's, consisting of a dish of wax, iron support for dish, alcohol lamp, set of five balls of different metals, and frame for placing all of the balls on the wax simultaneously 2.25



457

No. | Price.

456. **Roll of Sheet Lead,** ready for use in finding specific heat (see Gage's "Introduction to Physical Science," Exp. 112, page 148) . $ .20

457. **Apparatus A** (Hall & Bergen), improved form, for generating steam; made of heavy metal, securely mounted on a tripod of proper height for Bunsen Burner, including dipper.
Without Bunsen Burner 2.50

458. **Apparatus A,** cheaper form, without Bunsen Burner 2.00

A New Condensation Trap.

459

459. This little trap, made entirely of glass, is to be inserted between the Apparatus A and calorimeter (see Ex. XXIX., "Hall & Bergen's Physics"); will serve to catch the water resulting from condensation; very important .25

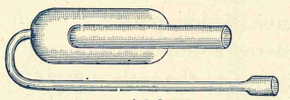
No.

460. **Calorimeter,** of nickel-plated spring brass, with flaring top, for Ex. XXVII., page 207, "Hall & Bergen's Physics" . . .45

460a. **Calorimeter,** of nickel-plated spring brass, cylindrical shape, for Ex. XXVII., page 207, "Hall & Bergen's Physics" . . .45

460b. **Fine Shot,** of suitable size for experiments in finding specific heat of a solid 10

461. **Brass Tube,** nickel-plated, for finding dew point 65



462

462. **Calorimeter,** for ice, after Bunsen, glass part alone, small . . .75

462a. **Calorimeter,** „ „ „ „ „ „ large . . 1.25

See also Calorimeters Nos. 942 and 944.

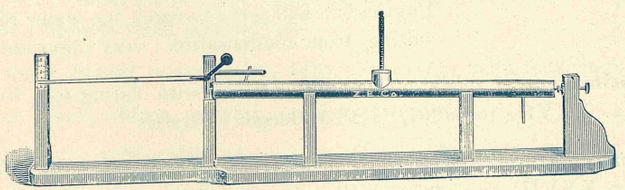
Effects of Heat.

Expansion, Conduction, Convection, Radiation.

No. Price.

463. **Brass Ring and Ball,** to illustrate expansion, with wooden handles $ .80

464. **Air Thermometer:** consists of a glass bulb 2 ins. in diameter, and stem of small bore 12 ins. long; for illustrating the expansion of air by heat 25



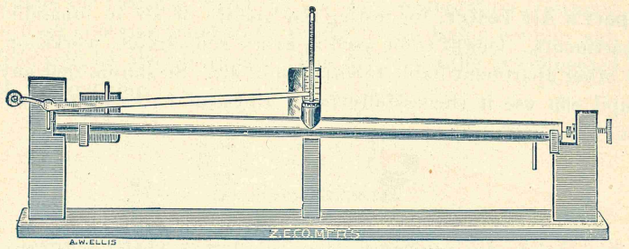
465

465. **Linear Expansion Apparatus,** Style A (see "Hall & Bergen's Physics," Ex. XXIV., page 181). This is now a most excellent piece of apparatus. It has a metal hinge, nickel-plated brass steam jacket, light metal pointer, and adjusting screw. At each end of the brass tube which passes through the nickel-plated steam jacket is soldered a short piece of pointed steel wire. A small mirror is attached to the scale, permitting quick and accurate readings to be taken. The base and upright supports are made of oak. Constructed in the best manner . . . 2.50

466. **Linear Expansion Apparatus** (same as No. 465), with nickel-plated tin steam jacket 2.25

467. **Linear Expansion Apparatus,** Style B (same as No. 465), but furnished with nickel-plated brass steam jacket, which does not have short central tube for thermometer 2.35

468. **Linear Expansion Apparatus** (same as No. 467), with nickel-plated tin steam jacket 2.15



469

No. Price.

469. **Linear Expansion Apparatus,** Style C. This apparatus is constructed in the same thorough manner as are our styles A and B, Nos. 465 and 467, but, occupying less table space, is perhaps a more convenient form of apparatus. The central position given the pointer, scale, and mirror will, we feel sure, meet with popular favor; with center tube for thermometer $2.50

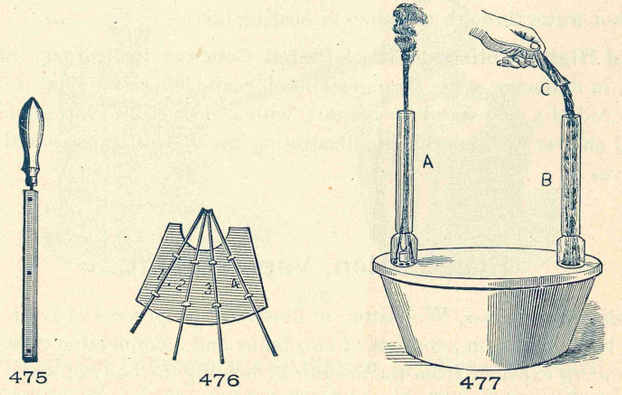
470. **Linear Expansion Apparatus** (same as No. 469), with nickel-plated tin steam jacket 2.25

471. **Linear Expansion Apparatus,** Style D, same as Style C, but without center tube for thermometer 2.35

472. **Linear Expansion Apparatus** (same as No. 471), with nickel-plated tin steam jacket 2.15

473. **Bent Glass Tube,** filled with dry air and mercury, for use in showing increase of pressure by heating a gas at constant pressure, each 1.76

474. **Galvanized Iron Ice Trays,** 60 x 15 x 5 centimeters, with four tubulatures, for Ex. XXV., "Hall & Bergen," each . . . 1.10



475 476 477

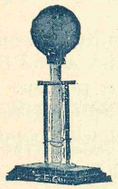
475. **Compound Bar,** for showing unequal dilation of different metals . .65

476. **Wires of Different Metals,** arranged in a suitable manner for testing their relative conductivities 25

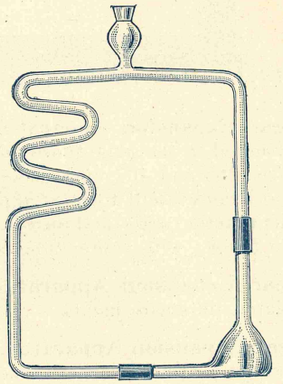
477. **Apparatus** to illustrate convection in gases 80

No. Price.

478. **Wolpert's Air Tester,** for testing the quality of air in inhabited apartments. Ought to be used in every schoolroom, workshop, or other apartment liable to vitiation of air. So simple that any pupil can use it successfully (see "Physical Laboratory Manual," by Gage) $1.50



478



479

479. **Circulating Apparatus,** improved form for showing convection currents in water. In use, hold the apparatus as shown in above illustration, fill with water and drop in a very small quantity of aniline through the funnel-shaped opening, and gradually apply heat to the bottom of large protuberance. This apparatus serves to illustrate, in a striking manner, the mode of circulation of hot water through the pipes in heating houses 1.00

480. **Pair of Highly Polished Nickel-Plated Concave Reflectors,** 10 ins. in diameter, with arrangements for attaching the same to the rod of a ring stand for support, with an iron ball. The same will answer for experiments illustrating the reflection of sound waves 2.00

Evaporation, Vaporization.

481. **Cryophorus,** of glass, Wollaston, to illustrate the process of freezing by evaporation; consists of two bulbs and a connecting tube, air being expelled from the interior by heating the body of water enclosed and hermetically closing the opening.

The water being poured into one bulb, the other bulb is placed in a mixture of ice and salt, which condenses the vapor and causes so rapid evaporation from the former bulb as to freeze the water therein 90

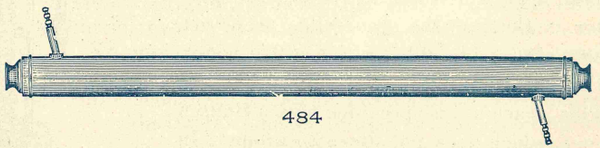
No. Price.

482. **Apparatus** for freezing water by its own evaporation (German). The flask contains water to be frozen. The bulbs contain sulphuric acid to absorb vapor. The delivery tube is connected with an air-pump $2.00

483

483. **Palm or Pulse Glass,** two bulbs and connecting tube filled with colored liquid 45

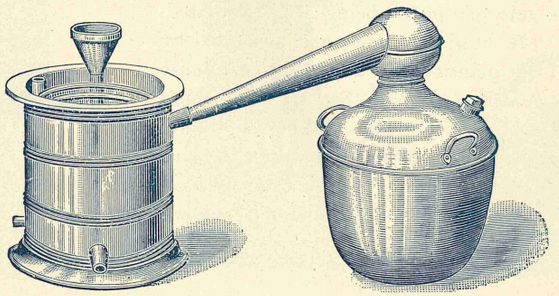
Distillation.



484

484. **Condensers,** made of brass, highly polished, 27 ins. long, 1¼ ins. in diameter 2.75

485. **Condenser for Distillation,** similar to Mohr's, contains 6 ft. of pure copper tubing, suitable for finest chemical purposes (see Fig. 130, page 138, "Introduction to Physical Science," by Gage), 2.00



486

486. **Apparatus for Laboratory Distillation of Water or Spirits,** consisting of a heavy copper tin-lined still with movable head, connected with pure block tin condensing form enclosed in zinc vessel, with proper inlets, tubulated, of very fine finish. Capacity, ½ gal., $7.00; 1 gal., $9.00; 2 gals., $10.50; 3 gals., $12.50; 5 gals. 16.00

Automatic Water Still.

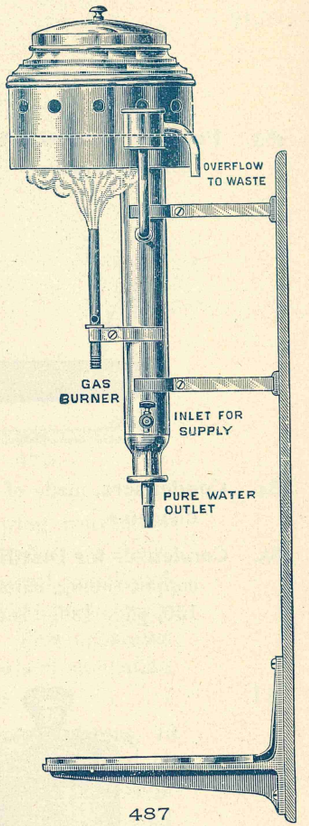
(Capacity 1-2 gallon per hour.)

No. Price.

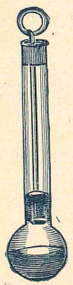
487. The Automatic Center Feed Water Distiller, shown in opposite cut, is especially adapted for constant and general use, in physical and chemical laboratories, or for domestic and many other purposes wherein the requirements of distilled water are beneficial. It can be fastened to the wall in any convenient place, close to the water and gas connection. A bottle or other vessel may be placed upon the shelf to receive the pure water. Bottles are generally preferred, which, after being filled with distilled water, can be corked and put away.

This machine is provided with a Bunsen burner, which does not deposit carbon. In lighting this burner, the gas should be turned on full before touching the match to the top of same. The water is fed into the retort from the condensing jacket at boiling temperature.

This apparatus is made entirely of finished and spun copper, and is very ornamental, all of the internal parts being well tin-plated. Only 10 ft. of gas per hour are consumed by it, and the quantity of water used to condense the steam is so small that its cost is not worth considering, but making a liberal allowance for cost of gas and water, the cost of pure distilled water is only about two cents per gallon. A full set of directions accompanies each water still . . $15.00

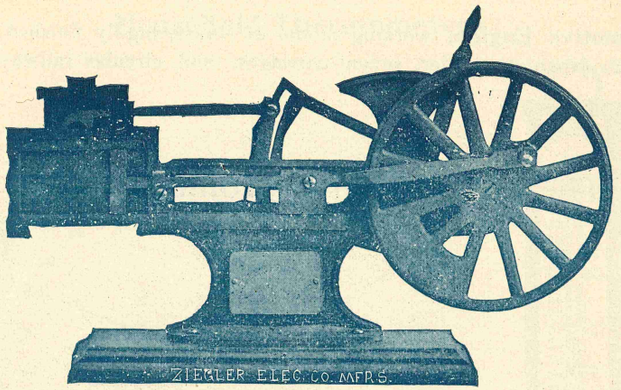


487


488

Steam Engine.

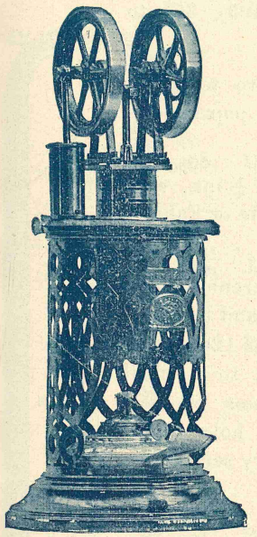
488. Model of Original Single-action Steam Engine. Heat the bulb (being half full of water) in a flame, and the stream will drive the piston up the tube; remove from the flame and place in cold water, and atmospheric pressure will force the piston back 75

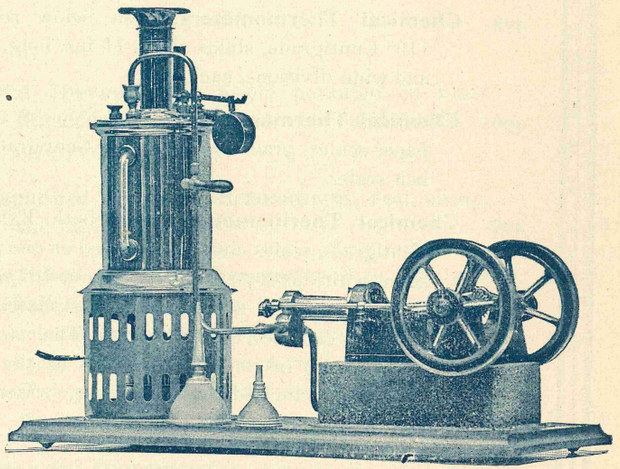


489

No. Price.

489. Model of a Steam Engine, showing movements of slide-valve, piston, eccentric, reversal of steam by means of link motion, and "cut-off." No pupil, after rotating the fly-wheel a few times, can fail to comprehend the functions and relations of these parts, and there is no mechanism which commands to an equal degree the interest and admiration of youth, and rightly so. Carefully adjusted and neatly mounted . $2.25


490


491

490. Hot-Air Engine, perfect upright working model, height over fly-wheel 12½ ins., nicely constructed, strong and durable . 9.00

491. Horizontal Steam Engine, perfect working model with all the essential parts of the modern engine and boiler, including safety-valve, high and low water gauge connecting pipe with stop-cock to shut off the steam from boiler and whistle; mounted on wooden base 13 x 5½ x ½ ins. and well suited for the purpose of class-room illustration 12.00

No.		Price.
492.	**Locomotive Engine,** working model of brass, highly finished, with japanned tender, seven carriages, and circular railway	$9.00

Thermometers, Hygrometers, Etc.

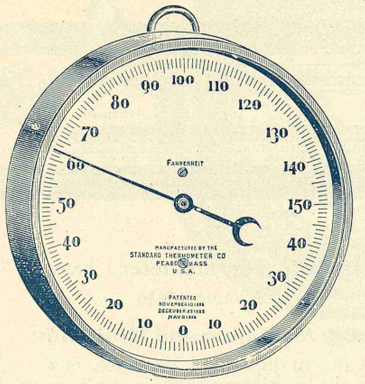
494

Chemical Thermometers.

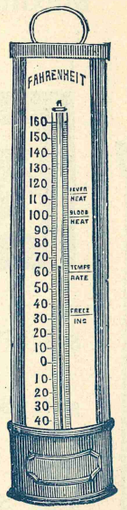
493.	**Chemical Thermometer,** etched stem, white back, graduated from below zero to about 360° Centigrade, in round hard-wood box, very exact	1.25
494.	**Chemical Thermometer** (same as No. 493), 30° to about 600° Fahr.	1.25
495.	**Chemical Thermometers,** from below zero to about 110° Centigrade, stems about 11 ins. long, paper scales and wide divisions, each	.70
496.	**Chemical Thermometers,** stems about 8 x ¼ ins., with paper scales, graduated in either Centigrade or Fahrenheit scales	.50
497.	**Chemical Thermometers,** with both Fahrenheit and Centigrade scales clearly engraved on one and the same stem, white back; range from about-10° to 120° Cent. The degrees are so wide that estimates to a small fraction can be easily made. The stems measure about 10 x ¼ ins., and will closely fit the hole of the ordinary perforated rubber stopper. Very serviceable and exact. Each	.80

All of the above-mentioned chemical thermometers are made of Jena normal glass.

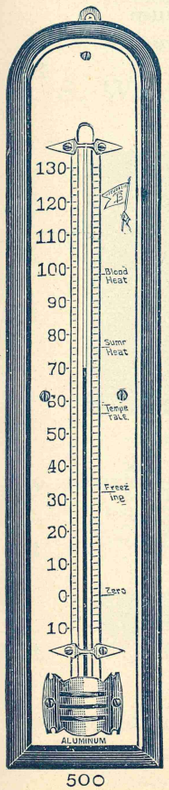
Household Thermometers.



498



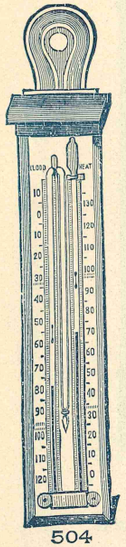
499



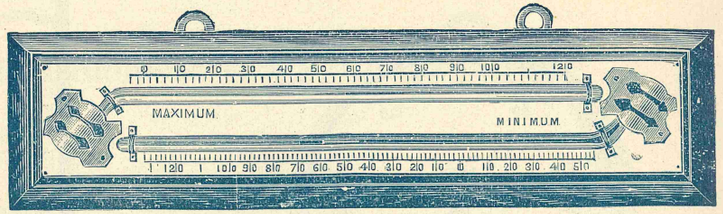
500

No.		Price.
498.	**Dial Thermometer,** nicely mounted on brass frame; can be easily read across and should be in every school-room	$2.50
499.	**Japanned Tin Case Thermometer,** neat, cheap, and fairly accurate	.25
500.	**Boxwood House Thermometer,** 8 in. tube and bulb are sunk so as to bring the mercury column even with the graduation of the scale; easily read, nicely finished, and very accurate. Scale graduated from 20° below zero to 130° above	.75
501.	**Boxwood Thermometer** (same as No. 500), with red spirit column instead of mercury . .	.75
502.	**House Thermometer,** similar to No. 501, mounted on hard-wood case, scale graduated from 30° below zero to 110° above, with either mercury or red spirit column; cheap and reliable .	.45

Maximum and Minimum Thermometers.

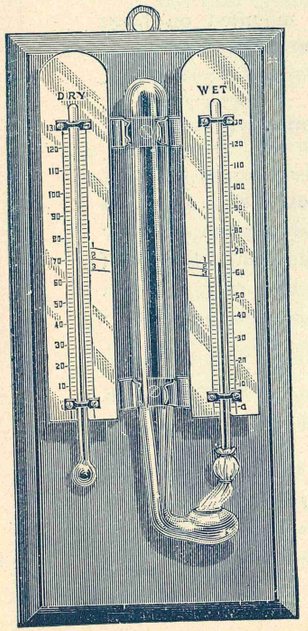


504



503

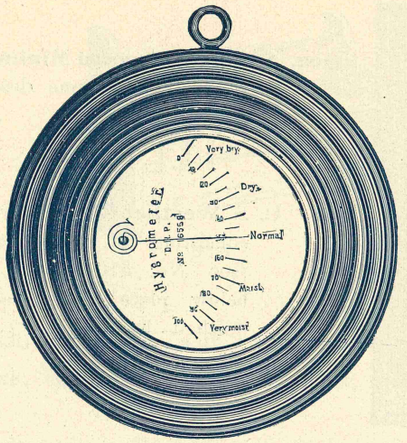
No.		Price.
503.	**Maximum and Minimum Thermometer,** handsomely mounted together on same plate . .	$3.00
504.	**Sixe's Self-Registering Maximum and Minimum Thermometer,** 8 in., in japanned tin case, boxwood scale, with magnet, Hick's make, very reliable	2.25
505.	**Sixe's Self-Registering Maximum and Minimum Thermometer,** 8 in., mounted on neat hard-wood frame, celluloid scale with magnet . . .	1.50



506

Hygrometers.

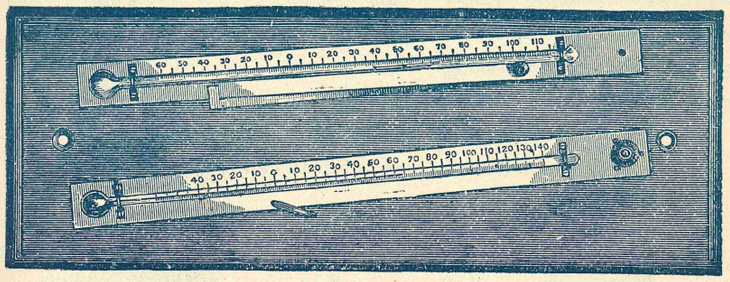
506.	**Mason's Hygrometer** (wet and dry bulb), with lines drawn on the scales for convenience in maintaining a humidity of 50° at normal temperatures of the living room, mounted on highly polished cherry or oak frame; size $10\frac{1}{2}$ x $4\frac{3}{4}$; scales raised from frame by insulating straps	4.00
507.	**Mason's Hygrometer,** in neat japanned tin case, Hick's make, very fine and reliable .	4.50



508

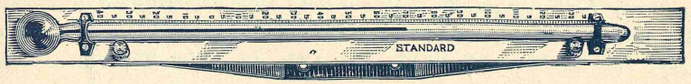
No.		Price.
508.	**Hygrometer,** giving humidity of the atmosphere, without reference to tables, neatly mounted on round wood frame . . .	$2.00

U. S. Weather Bureau Thermometers and Hygrometers.



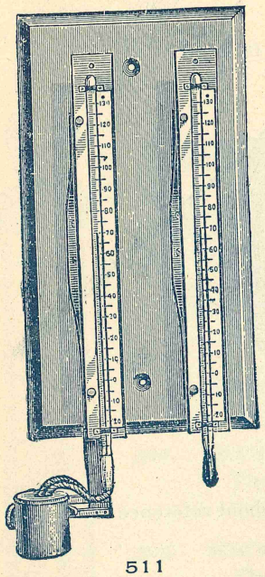
509

509. **Maximum and Minimum Thermometers,** latest pattern, mounted together on polished oil-finished back. Certificate furnished with each thermometer, per set 8.00



510

510. **Standard Exposed Maximum Thermometer,** 12 in. round bulb, graduated on silvered metal plate, furnished with support and binding screws 2.50



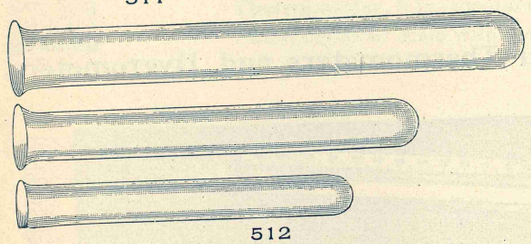
511

No. Price.

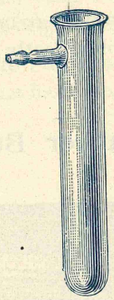
510a. Standard Exposed Minimum Thermometer, of same description as last $2.50

511. U. S. Weather Bureau Hygrometer, consisting of two thermometers (see No. 510), bulbs extending below plate; mounted on oil-finished back 6.00

Accessories.



512



513

514

512. Test Tubes, of best German glass, even thickness, free of lead and well annealed.

Size,	3 x $\frac{3}{5}$,	4 x $\frac{1}{2}$,	5 x $\frac{1}{2}$,	5 x $\frac{5}{8}$,	6 x $\frac{5}{8}$ ins.
Price,	$ .20	$ .25	$ .30	$ .30	$ .35 per doz.
Price,	1.75	2.50	2.75	3.00	3.65 „ gross.

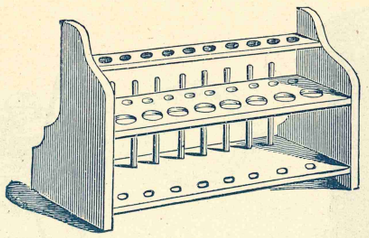
Size,	6 x $\frac{3}{4}$,	7 x $\frac{7}{8}$,	8 x 1 ins.
Price,	$ .35	$ .50	$ .60 per doz.
Price,	3.75	5.00	6.50 „ gross.

513. Test Tubes, side neck.

Size,	5,	6,	8,	10 ins.
Price,	$ .10	$ .12	$ .15	$ .20 each.
Price,	.75	.85	1.30	2.00 per doz.

514. Test Tubes, on foot, with lip, well made.

Size,	4,	5,	6,	7,	8,	10 ins.
Price,	$ .08	$ .10	$ .12	$ .14	$ .18	$ .20 each.
Price,	.75	.85	1.00	1.20	1.50	2.00 per doz.



515

No. Price.

515. Test Tube Rack, for 18 tubes, with 8 pins for draining . . $ .70

516. Test Tube Rack, improved form, for 12 tubes, with 6 pins for draining 45

517. Test Tube Rack (same as No. 516), with 12 drain pins . . .55

518. Brushes for cleaning Test Tubes, on twisted brass wire, with sponge end, each 10
Per doz. 1.00

519. Test Tube Holder, something new; made of nickel-plated spring brass wire; will clamp test tubes of any size; far superior to any wooden holder, each 15

520. Clamps for holding Test Tubes on side of battery jar, as shown in Fig. XX., "Hall & Bergen's Physics," each 15

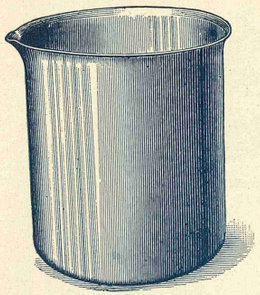
521

522

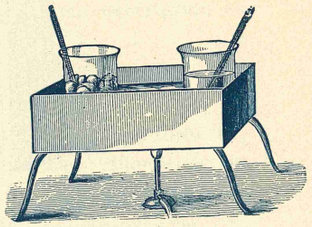
521. Flasks, of best German glass, well annealed, vial mouth, flat bottom.
Capacity, 100, 200, 300, 400, 500, 750, 1,000 1,500, 2,000, 2,500, 3,000 cc.
Price, 8 10 12 14 16 19 22 30 36 42 50 cts. each.

522. Flask, round bottom, of best German glass, well annealed, vial mouth; to illustrate boiling under low pressure with stopper . .35

523. Flask, with side tube; capacity 400cc., for use in testing the boiling point of a thermometer 40



524



525

No. Price.

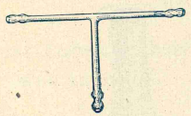
524. **Copper Beakers,** made of heavy polished copper, with lip.
Size, 125, 250, 500, 1,000 cc.
Price, $ .60 $ .70 $ .90 $1.10

525. **Long Copper Vessel,** on iron frame, for heating liquids, very useful, $3.00

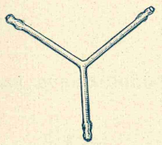
526. **Bohemian Glass Beakers,** nest of five, tall form, without lip, capacities ranging from 2½ to 15 ozs. 75

527. **Bohemian Glass Beakers,** without lip, tall form, 4 oz., 12 cts.; 10 oz., 22 cts.; 15 oz., 25 cts.; 40 oz. 40

Glass Jars of different sizes, see Battery Jars, page 144.



528



528

529

528. **Tubes of Glass,** T or Y form, diameter of bore, ½ in., 25 cts.; ⅜ in., 20 cts.; ¼ in., 15 cts.; ⅛ in. 10

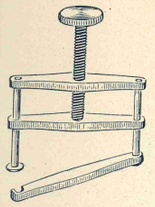
529. **Watch Glasses,** 2 ins. in diameter, well annealed, edges ground, per doz. 25

530. **Glass Tubing,** bore 1 to 2 millimeters, in 1 meter lengths, per lb. .75

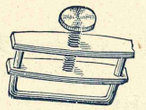
531. **Glass Tubing,** soft, best American make, any size up to 1 in. in diameter, per lb. 35

532. **Glass Tubing,** soft, best German make, any size up to 1 in. in diameter, per lb. 50

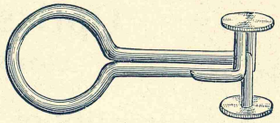
533. **Glass Beads,** broken form, per pint 1.25



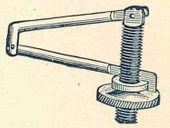
534



535



536



538

No. Price.

534. **Screw Compressor,** of improved construction, nickel-plated, can be attached to rubber tubing without opening joints . . . $ .30

535. **Screw Compressor,** brass (same as No. 534) but closed at bottom 20

536. **Spring Compressor, Mohr's,** nickel-plated, small 15

537. **Spring Compressor, Mohr's,** nickel-plated, large 20

538. **Lever, Screw Compressor,** nickel-plated 35

539. **Rubber Gas Tubing,** of best quality, thick wall, ¼ in. bore; very flexible, per ft. 12

540. **Rubber Tubing** of best quality, for connections, $\frac{3}{16}$ in. bore and $\frac{1}{32}$ in. wall; per ft. 06

541. **Rubber Tubing** (same as No. 540), ¼ in. bore and $\frac{1}{16}$ in. wall; per ft. 10

(Prices on larger and smaller sizes tubing given on application.)

542. **Rubber Stoppers,** of best quality, solid or with one and two holes; either, per lb. 2.00

Note: When ordering Stoppers, give diameter of small end, and state whether wanted solid or with one or two holes.

543. **Paraffine,** per lb. 30

544. **Copper Sulphate,** per lb. 10

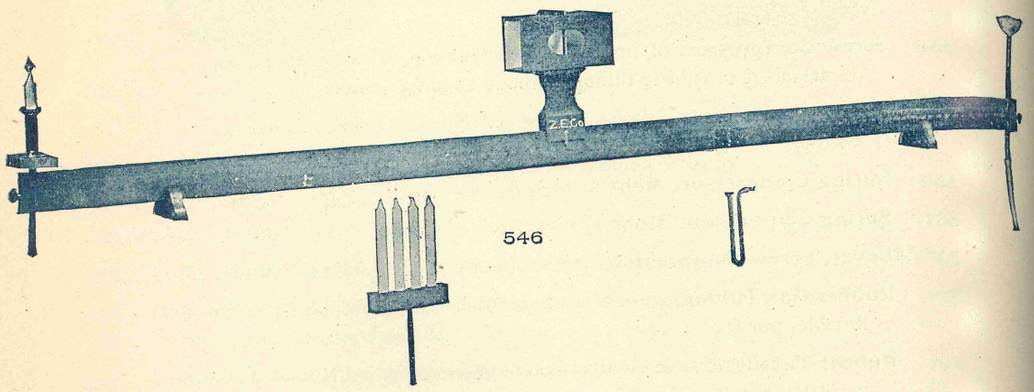
(Special prices on this article in larger quantities.)

545. **Bisulphide of Carbon,** in glass bottles, per lb. 40

N. B. — Send thirty cents for our little Note Book of Tables, Diagrams, and Useful Information. See page 24.

Optics.

Intensity of Light.

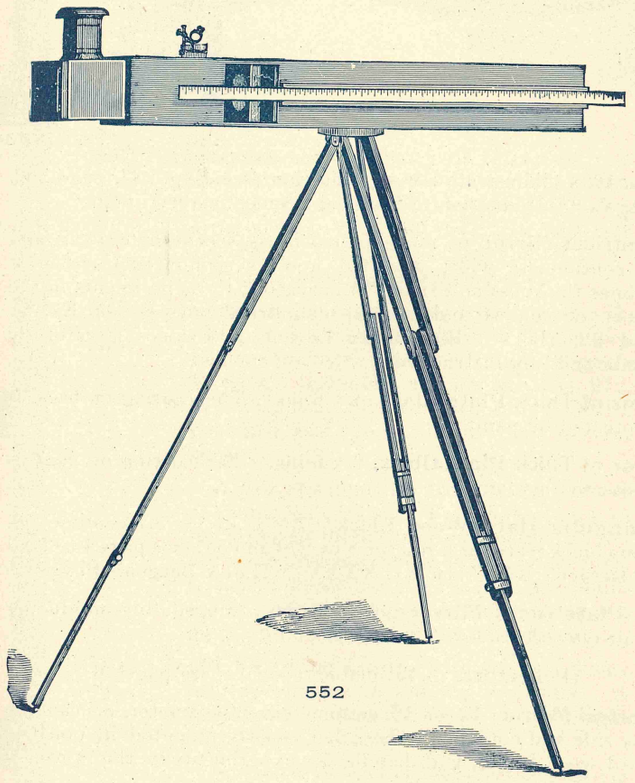


546

No.		Price.
546.	**Photometer after Bunsen,** of improved construction, for use in a dark room whose walls are painted a dead black, or in a space separated from a light room by black curtains, consisting of optical bank, 8 ft. 6 ins. long, with supports, sliding box fitted with mirrors, and a disk with transparent circle, gas burner, set of four lava tips, supports for one and four candles, glass U-tube, etc. (see Ex. 163 and 164, Gage's "Physical Laboratory Manual," also pages 328 and 329, Gage's "Principles of Physics"). This is a finely made and most excellent instrument for measuring the strength of light rays	$7.00
547.	**Photometer after Bunsen,** for use in a lighted room. The hoods, scales, and screen are arranged in a well-made, covered box	5.00
548.	**Photometer after Rumford,** with scales and screens (see Ex. XXXIV., page 281, "Hall & Bergen's Physics") . . .	3.00
549.	**Photometer after Sumner and Bradhun,** imported to order only.	.25
550.	**Candles of Paraffine,** per dozen	.30
551.	**English Standard Paraffine Candles,** each	

See Camera Obscura under "Lecture Room Outfit," p. 219; an apparatus for illustrating the formation of images by means of small apertures.

Photometer, Portable. Bunsen Type.



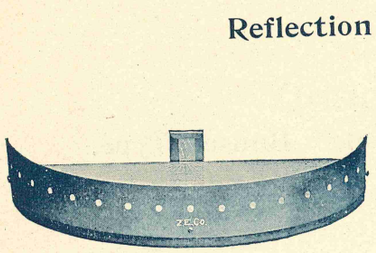
552

No.		Price.
552.	**Photometer,** suitable for tests where the ordinary form of fixed photometer is not applicable. Can be used on the street or elsewhere	$27.00

The photometer box is of handsomely finished wood 37 x 5 x 5 ins. The whole outfit is convenient and portable. The stand is adjustable for different heights.

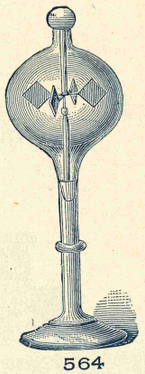
553.	**Additional Attachment** for use with arc lamps . . .	17.50

Reflection of Light.



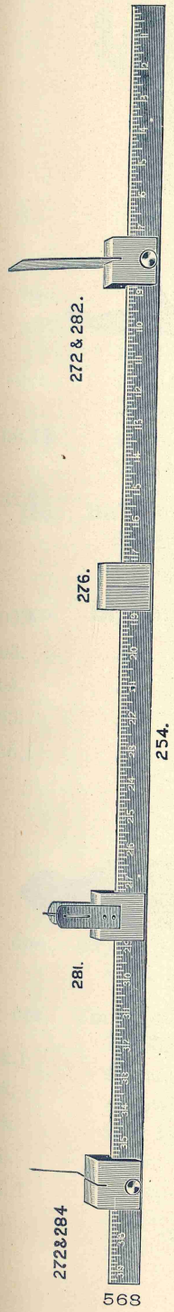
554

560

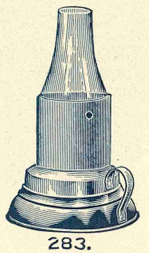

564

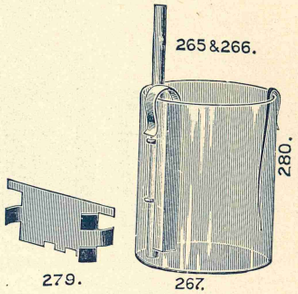
No.		Price.
554.	**Apparatus** to illustrate law of reflection (see Exp. 234, page 292, Gage's "Introduction to Physical Science"), very unique	$ .85
555.	**Cylindrical Mirror** of nickel-plated brass, 4 centimeters tall and 5 centimeters wide, mounted upon a semi-circular base of proper thickness and radius of curvative, for experiments in the study of convex and concave cylindrical mirrors (see Ex. 21 and 22, Hall's "Elementary Lessons in Physics"), carefully made and very instructive	.50
556.	**Mirror of Thick Plate Glass,** 4 x 6 ins. The coating on back is protected by paint	.30
557.	**Mirror of Thick Plate Glass,** 2 x 6 ins. The coating on back is protected by paint	.18
558.	**Rectangular Hard-Wood Block,** 7.5 x 7.5 x 3.7 centimeters. This block serves as a rest for Nos. 274 and 557 (see page 45, "Hall & Bergen's Key," also Ex. XXXV., "Hall & Bergen's Physics")	.15
559.	**Two Plate Glass Mirrors,** 6 x 6 ins., hinged, for producing multiple reflections	1.75
	(**Reflectors,** nickel-plated, concave, see page 70.)	
560.	**Spherical Mirror,** 12 or 15 centimeters in diameter, concave on one side and convex on the other, neatly mounted in polished hard-wood frame, with handle, for experiments in the study of formation of images, etc.	2.25
561.	**Kaleidoscope,** in neat paper case	.35
562.	**Kaleidoscope,** brass case	1.25
563.	**Kaleidoscope,** brass case, with stand	2.50
564.	**Crooke's Radiometer,** for indirectly transforming radiant energy into mechanical work (see Gage's "Principles of Physics," page 419), best quality and size	2.50
565.	**Crooke's Radiometer,** same as last, only smaller	1.75
566.	**Crooke's Radiometer,** with two sets of vanes revolving in opposite directions	4.00

Refraction of Light.



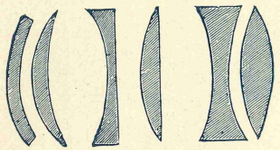
568


283.

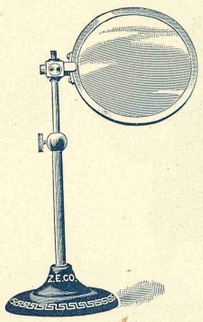


279. 267.

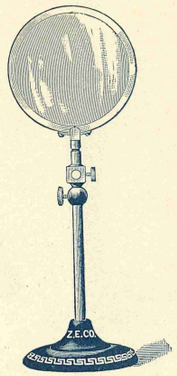
No.		Price.
567.	**Apparatus** showing index of refraction from air to water (as described in Hall's "Elementary Lessons in Physics," and including articles Nos. 265, 266, 267, 279, 280; see Laboratory Outfit, page 214, and above illustration), without measuring stick	$ .58
568.	**Apparatus** for experiments with lenses, complete, as described in Hall's "Elementary Lessons in Physics," and "Hall & Bergen's Physics," including articles Nos. 254, 272, 276, 281, 282, 283; see Laboratory Outfit, page 215, and opposite illustration), without lamp	1.10
	A pair of supporting blocks for meter rod accompanies each set. Two sides of each of the different blocks furnished with this set are made tapering (not shown in above illustration) and a mark is made across the middle of each tapering side, thus enabling a quick and accurate reading to be taken.	
283.	**Small Kerosene Lamp,** with asbestos shade, for experiments in the foci of lenses. A small hole is cut in the shade at the height of the flame. Each	.35
	For prices of the individual articles used in the experiments with lenses, see Laboratory Outfit, pages 214 and 215.	
569.	**Double Convex Lens,** 10 centimeters focus, each	.10
570.	**Double Convex Lens,** focus 15 centimeters, each	.10
571.	**Double Convex Lens,** 8 centimeters diameter, focus 15 centimeters	.70
572.	**Double Convex Lens,** 5 centimeters focus, each	.80
573.	**Double Convex Lens,** 10 centimeters diameter, 40 centimeters focus	1.10



574

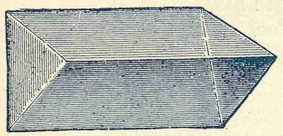


576



576

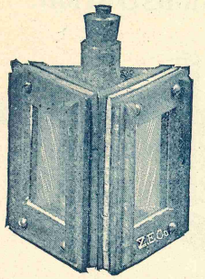
No.		Price.
574.	**Set of Six Demonstration Lenses,** 1½ in. diameter, in pasteboard box	$1.00
575.	**Set of Six Demonstration Lenses,** 2 in. diameter, in neat hard-wood box, divided off into partitions for each lens	2.25
576.	**Mounted Lens,** 10 in. focus, 5 in. diameter. This lens, as shown in the two illustrations above, can be raised and lowered to any desired height or inclined to any angle. We recommend it for use with our Porte-Lumière, No. 620	4.50
577.	**Prism,** glass, square ends, narrow faces, 3 in.	.30
578.	**Prism,** „ „ „ 4 „	.40
579.	**Prism,** „ „ „ 6 „	.60
580.	**Prism,** „ „ „ 8 „	1.50



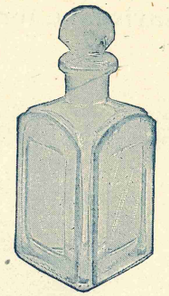
581

582

581.	**Prism,** glass, very pure and of high refractive power, nicely polished, 60°, faces 100 x 45 millimeters	1.25
582.	**Equilateral Prism,** glass, with cut handles, 3 in.	.30
583.	**Equilateral Prism,** „ „ „ 4 „	.40
584.	**Equilateral Prism,** „ „ „ 6 „	.60
585.	**Equilateral Prism,** „ „ „ 8 „	1.50
586.	**Iron Clamp and Glass Plates,** for showing Newton's Rings	.40
587.	**Red and Blue Glasses,** each	.10



588



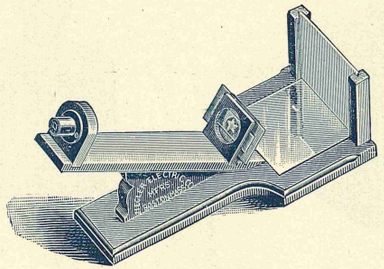
589

No.		Price.
588.	**Bisulphide of Carbon Prism,** consisting of a three-faced brass bottle, with glass slides, for bisulphide of carbon (no other liquid ought ever to be put into this bottle), for projecting the solar spectrum, accompanied by explicit directions which will enable the most inexperienced to project upon a screen from sixteen to twenty Fraunhofer's lines	$2.50
589.	**Bisulphide of Carbon Prism,** hollow, made entirely of glass, bottle form, with ground-glass stopper and highly polished faces, nicely made, each	5.50
590.	**Bisulphide of Carbon,** in glass bottle, 1 pound	.40

600

600.	**Crystals of Iceland Spar,** very fine specimens for double refraction	.40 to .85
601.	**Tourmaline Tongs** (see Ex. 198, Gage's "Laboratory Manual"). In addition to this exercise, require the pupil to place the slices of tourmaline so as to cut off the light, then place between the slices an ordinary glass lens of a pair of eye-glasses; afterwards substitute for the glass lens a pebble (quartz) stone lens, such as are much used in eye-glasses. The latter will so twist the plane of vibration of the polarized ray as to admit of its passing through the farther slice. In this way pebble lenses may easily be distinguished from glass lenses	3.00

Polariscope for Class Demonstration.



602

No. Price.

602. **The Polarizer** in this instrument is a plate of glass, which rests upon the blackened surface of a neat hard-wood base. A wooden arm inclined at the proper polarizing angle serves as a support for the analyzer and the object holder.

The analyzer employed is a Nichol's prism of excellent quality, which rotates smoothly in a brass mounting attached to the inclined arm.

A stage to rest objects against is fastened to the lower end of the inclined arm. To cut off the images of outside objects a plate of ground glass is placed in an upright frame just beyond the polarizer.

This instrument serves nicely for all experiments upon the interference of polarized light in passing through thin films, both in plain and circular polarization. Mica and selenite designs are well shown by it.

As an efficient and cheap polariscope, suitable for class demonstration, it has no equal. Complete $5.00

603. **Polariscope,** cheaper form 3.50

604. **Star-shape Mica Specimens,** mounted on glass for use with polariscope, each 1.00

For price of Prince Rupert Drops, for examination with polariscope, see No. 602.

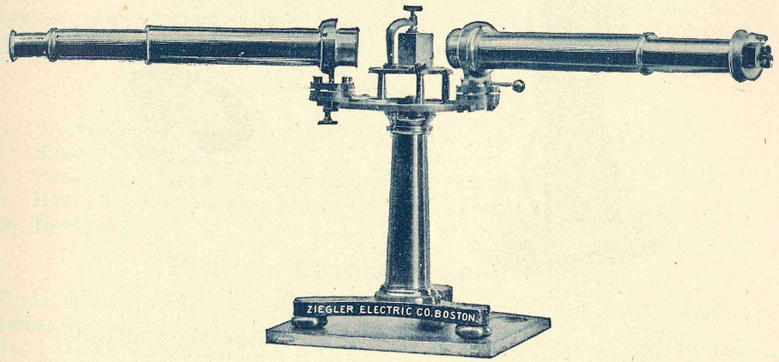
605. **Nichol's Prism** for polarization, $3.00 and upwards.

Spectroscopes.

606

606. **Direct Vision Pocket Spectroscope,** with adjustable slit and screw movement, in morocco case; very fine 10.00

607. **Miller's Spectroscope** for school use, has large prism, adjustable slit, etc. 20.00



608

No. Price.

608. **Browning's Student Spectroscope,** in cabinet $60.00

This instrument is offered as an accurate and well-made piece of apparatus, capable of good work at a low price, has a prism of extremely dense glass of superior workmanship. The circle is divided and reads with a vernier, thus dispensing with the inconvenience of an illuminated scale. This arrangement possesses the very great advantage of giving angular measures in place of a perfectly arbitrary scale. The telescope is provided with spider line, which can be adjusted to any part of the spectrum. The slit is furnished with a reflecting prism, by means of which two spectra can be shown in the field of view at the same time. The moving parts are of great solidity and the instrument throughout is designed to reduce the flexure and vibration of its parts to a minimum.

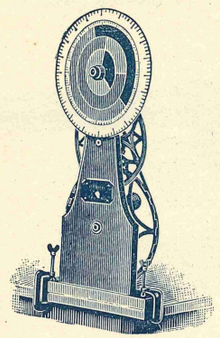
Send for special-duty-free price on Browning's Student Spectroscope.

609. **Bottles,** filled with salts of barium, copper, potassium, lithium, and strontium, for spectrum analysis, each 15

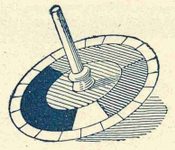
Recomposition of Light.

610. **Newton's Color Disc,** large, of stout cardboard, and five other interesting color discs (see pp. 390 and 391, Gage's "Principles of Physics"). 1.00

611. **Set of Discs,** small, to illustrate composition of colors 50



612



613

No.		Price.
612.	**Set of Discs,** comprising four sizes of color discs, eight of each size, and graduated discs. The color discs are cut so that the combinations which can be made in the circle, showing tints, shades, hues, complimentary colors, broken colors, values, etc., are almost endless, and exceedingly valuable in color investigation. In the above engraving three sizes of discs are shown in combination, with the graduated disc at the back. The Rotating Machine shown in above engraving is not included with the set of discs. For price of our Improved Rotating Apparatus, see No. 220. Set of discs as described in box	$2.00
613.	**Color Top;** consists of wooden spindle with a sliding nut, a graduated pasteboard disc, eight thin paper discs 1½ ins. in diameter in the six standards with white and black, and eight other discs in duplicate colors ¾ in. in diameter. In use, all the large paper discs should be carefully slitted from circumference to center with scissors, as should also the small black and white discs; but the other small discs will generally be used whole as standards for comparison, although they also may be slitted if so required. With this simple instrument the intermediate spectrum hues can be produced by combining the standards, also the tints and shades, and broken colors in neutral grays can be illustrated, as also the complimentary colors which will make a neutral gray. With a set of Discs No. 612 in the hands of a competent teacher, and a color top in the possession of each pupil, such progress in color perceptions can be made as has never been possible by other means. Each top is enclosed in an envelope with set of directions for using. Price per dozen . . . . . .50 A sample top will be mailed to any address on receipt of . .06

Prang's Standard Colored Papers.

These papers are manufactured in full sheets, 24 x 28, and may be had in this size as well as in packages of smaller sheets, as specified in the price-list following, also in books where each color is marked. They are prepared with pigments which are absolutely free from arsenic.

Prices.

No.		Price.
614.	**Sheets,** 24 x 28 in any color, per ream, prices on application.	
615.	**Sheets,** „ „ „ „ quire, „ „	
616.	**Package,** 4 x 4, containing 12 normal unit colors, unmarked .	$ .10
617.	**Book,** 3 x 4, containing 155 colors, marked with names . . .	.30
617a.	**Book,** 1 x 4, „ „ „ „ „ . . .	.10

Prang's Standard Color Charts.

These charts are 10½ x 28 ins. in size, with a cover to protect the colors from light and dust when not in use.

No. 1 shows the normal tone of twelve standard colors, R, RO, O, YO, Y, YG, G, BG, B, BV, V, and RV.

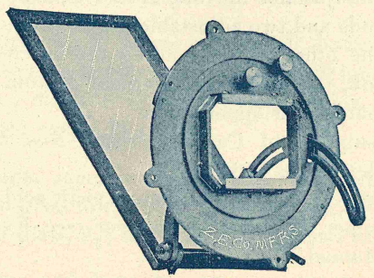
No. 2 shows the normal tone of twenty-four standard colors,—

R	O	Y	G	B	V
BRO	OYO	YYG	GBG	BBV	VRV
RO	YO	YG	BG	BV	RV
ORO	YYO	GYG	BBG	VBV	RRV

No.		Price.
618.	**Price** for either No. 1 or No. 2, per copy	$ .75
619.	**One pan each,** yellow, and blue pigments with camel's-hair brush	.40

New Porte-Lumière.

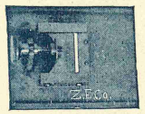
To conduct successfully a course in experimental optics, an instrument suited to introduce a beam of sunlight into a darkened room, and there direct it at option, is obviously indispensable. This step taken, not only does a great variety of experiments in optics become possible and easy, and this branch of physics become one of the most delightful in all science, but the way is opened for at least a novel way of illustrating nearly every subject in physics, as Professor Dolbear has clearly demonstrated in his invaluable work on the "Art of Projection." This instrument is easily and quickly adjusted to the movements of the sun, and can be operated by a child ten years of age. It is constructed entirely of brass, and in a most thorough and durable manner.



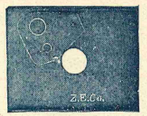
620

No.		Price.
620.	**Porte-Lumière and Slide-holding Disc,** as described, with directions for use	$8.00
	Double Convex Lens, 5 ins. in diameter, extra (see No. 576).	

Accessories for Projection.

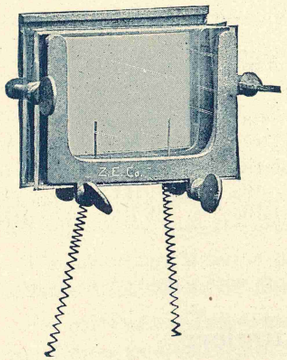


621

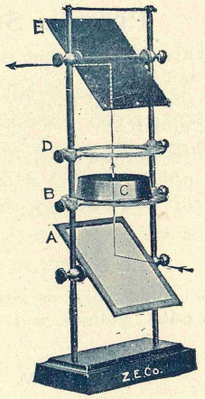


622

No.		Price.
621.	**Disc with Adjustable Slit,** necessary in projection of spectrum,	$ .85
622.	**Disc with Three Circular Apertures,** $\frac{1}{4}$, $\frac{1}{2}$, and 1 in. diameter .	.30
623.	**Dolbear's "The Art of Projection,"** revised and enlarged .	1.65



624



625

624. **Tank with Platinum Electrodes,** suited for projection of phenomena attending electrodes, especially the celebrated "tin and silver trees" (see Gage's "Principles of Physics," page 477) 2.50

625. **Attachment for Vertical Projection.** This attachment, represented in the accompanying cut, may be used with any porte-lumière or stereopticon for vertical projections of all kinds. It consists of two adjustable mirrors, *A* and *E*, supported by two upright brass rods and two adjustable stages — one, *D*, for holding the lens, the other, *B*, for holding the articles to be projected. A tank, *C*, with a plate-glass bottom for holding liquids, accompanies this apparatus 5.00

See also Bisulphide of Carbon Prisms, Nos. 588 and 589, and mounted lens, No. 576.

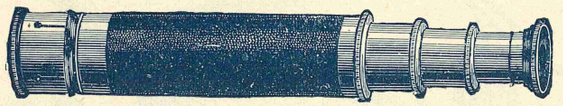
626. **One bottle each** of permanganate of potash, picric acid, ammoniated sulphate of copper, and oxide of copper (see Ex. 185, Gage's "Laboratory Manual") 80

627. **Strips of Red and Blue cardboard,** 18 x 3 ins. (see Ex. 187, Gage's "Laboratory Manual"), each 08

628. **One ounce each of Eosine and Sulphate of Quinine** (see Ex. 189, Gage's "Laboratory Manual") 1.00

Achromatic Portable Telescopes.

11 Lignes = 1 inch.



629-635

Portable Telescope, black morocco covered body, highly burnished brass draw tubes, according to size, as follows: —

No.	Dimensions. Open.	Closed.	Diameter of Object-Glass.	Magnifying Power.	Price.
629.	13½ ins.	5 ins.	10 lignes	10 times . .	$2.00
630.	16½ „	6 „	12 „	15 „ . .	2.50
631.	17 „	6¼ „	13 „	20 „ . .	3.50
632.	17 „	6½ „	14 „	20 „ . .	4.00
633.	23 „	8 „	16 „	25 „ . .	5.00
634.	30 „	9¾ „	19 „	30 „ . .	7.00
635.	34 „	10¼ „	22 „	35 „ . .	11.00

636. **Portable Telescope,** polished mahogany covered body, highly burnished brass draw tubes. Dimensions and prices as above.

637. **Portable Telescope,** black morocco covered body, four draws, with sunshade to extend over object-glass. Full length, 36 ins.; closed, 10½ ins.; diameter of object-glass, 2 ins.; magnifying power, 40 times; range, 14 miles 13.00

638. **Portable Telescope,** black morocco covered body, four draws, with sunshade to extend over object-glass. Full length, 45½ ins.; closed, 12¾ ins.; diameter of object-glass, $2\frac{3}{11}$ ins.; magnifying power, 45 times; range, 18 miles 18.00

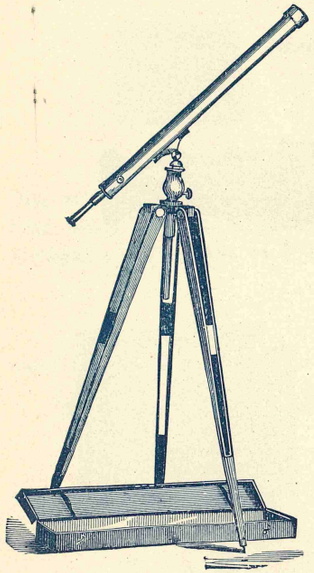
639. **Portable Telescope,** superior lenses, polished mahogany body, four draws, sun-glass to eye-piece. Full length, 48 ins.; closed, 13½ ins.; object-glass, $2\frac{5}{11}$ ins.; power, 55 times; range, 25 miles 33.00

640. **Celestial Eye-piece,** for No. 639, giving power 135 times . . 7.00

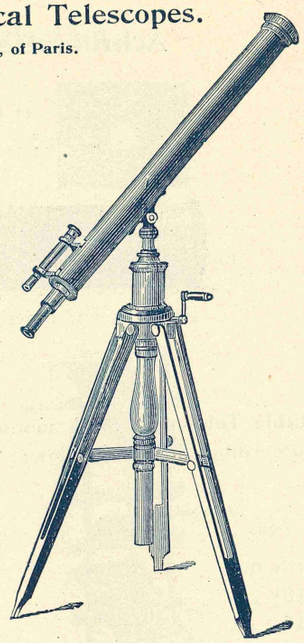
Nos. 639 and 640 are valuable instruments for making observations of the sun, moon, satellites of Jupiter, etc.

Achromatic Astronomical Telescopes.

Manufactured by BARDOU, of Paris.



641



643

No. Price.

641. **Astronomical Telescope,** with body and movements of highly finished lacquered brass, rack and pinion for adjustment of focus, object-glass 3 ins. in diameter, one terrestrial eye-piece and one celestial eye-piece, with sun-glass, affording, respectively, powers of 45 and 100 diameters; packed in strong wood case, with lock and key. The telescope is mounted upon a firm walnut tripod stand, with altitude and azimuth movements, and arrangement for setting at any desired height for convenient observation; complete $65.00

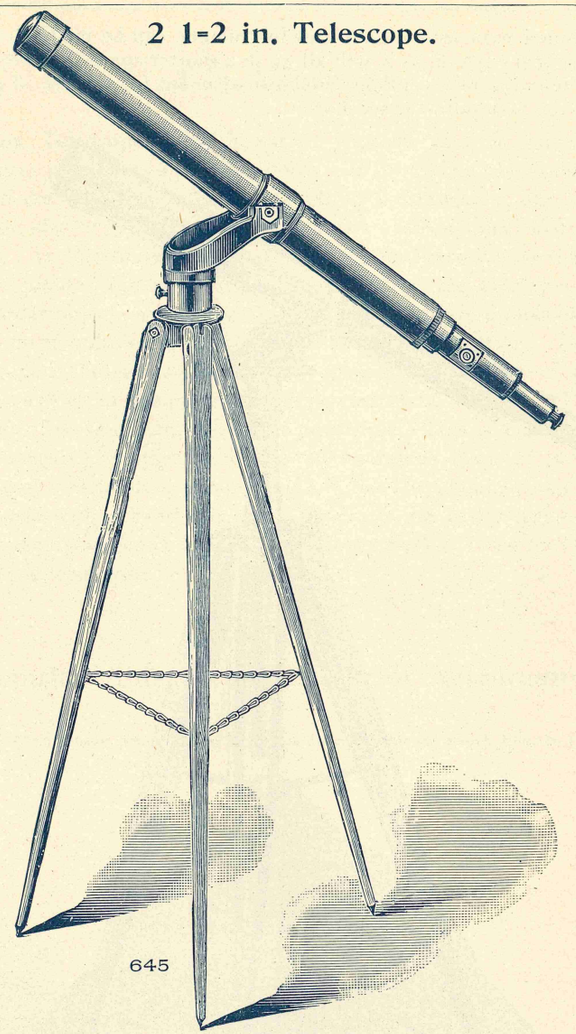
642. The same with Achromatic Finder 85.00

643. **Astronomical Telescope,** body with finder and movements of highly finished lacquered brass, rack and pinion for adjustment of focus, object-glass 3¼ ins. in diameter, two terrestrial eye-pieces, affording, respectively, powers of 50 and 70 diameters; three celestial eye-pieces, with sun-glass, powers of 75, 100, and 150 diameters; packed in strong walnut case, with lock and key. The telescope is mounted upon a very finely polished, firm mahogany tripod stand, with folding legs, and can be adjusted to any desired height by a rack and pinion operated by a crank; complete 175.00

644. **Astronomical Telescope,** similar to above, having object-glass 3½ ins. in diameter, with two terrestrial eye-pieces, affording, respectively, powers of 60 and 80 diameters, and three celestial eye-pieces, with sun-glass, powers of 100, 135, and 175 diameters; complete 225.00

Any of the above imported free of duty. Prices given on application. Prices on larger sizes furnished on application.

2 1-2 in. Telescope.



645

No. Price.

Height of tripod, 57 ins. Height of trunnion above tripod, 7 ins. Length of tube when not extended, 35 ins.

645. **This instrument** is mounted as described and shown in above cut. It is equipped with one terrestrial and one celestial eye-piece; and to the latter is attached a sunshade for solar observation, which is easily removed, when the eye-piece can be used for ordinary observations. The power of the terrestrial eye-piece is 26, while that of the celestial is 50. This instrument is of the very best American make, and is not a mere toy, but is capable of being used for many observations of real value. It is surprising how much can be done with an instrument of this size. When used on the sun and moon, the planets, and many of the most interesting nebulæ and stars, it will give very satisfactory results. Price, complete $45.00

At an additional expense of $2.00 this instrument can be made so that it may be packed in an ordinary trunk, as it will all go in a shorter space than thirty-five inches.

This will be found to be a very convenient instrument for the use of people passing the summer at the mountains or seashore.

646

3 in. Telescope.

As Sold with the $90.00 Outfit.

Height of tripod	45 ins.
Height of trunnion	60 „
Length of tube when not extended	40 „

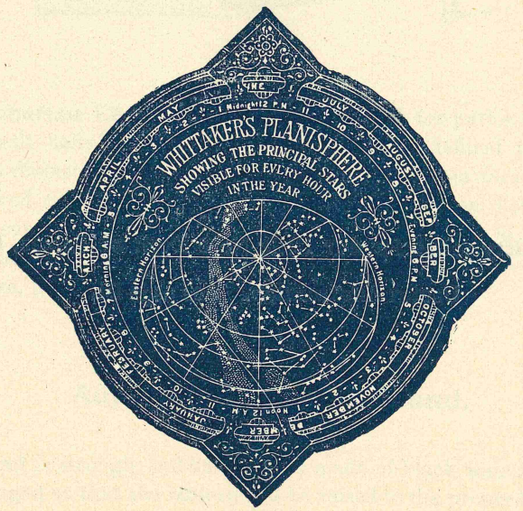
3 in. Telescope.

No. Price.

646. **The 3 in. Telescope** shown in cut on opposite page is perhaps the most popular as a portable outfit. It is of very best American make and is not large enough to be unwieldy, but has enough size to give good satisfaction as an astronomical instrument. An instrument of this size will do most satisfactory work on the planets, the sun, and the moon. All of the most popular stellar objects can be shown by it, and it will do double-star work up to quite close doubles with the finest definition. This telescope includes one terrestrial eye-piece giving a power of 40, and two celestial eye-pieces giving powers of 50 and 80. The former of these is a three-quarter periscopic. This is a genuine comet-seeking eye-piece, and has an enormous field, of great brilliancy. The other eye-piece is a ½ in. Huyghenian, and is furnished with a sunshade. The latter can be easily removed when the eye-piece is desired for ordinary work. Price for this telescope, complete, is $90.00

Popular Aids to the Study of Astronomy.

Revolving Planisphere, showing the Principal Stars visible for every Hour in the Year.



647

25,000 have been sold. Price, 60 cts.

No.

647. This Novel Planisphere consists of a circular disc on which the principal stars visible from our latitude are clearly indicated. By means of an exceedingly simple arrangement the disc may be made to revolve in such a way as to show only those stars visible at any given time. In addition to this may be shown the varying time of sunrise and sunset during the whole year.

The stars are clearly shown in white on a dark ground.

We invite the attention of all interested in astronomy to this *unique* and *cheap* publication, which, it is hoped, will tend to popularize and simplify the study of the heavens.

Klein's Star Atlas.

Price.

648. This is a Fine Star Atlas, and will prove especially valuable for the tyro in astronomy, as it enables one to do intelligent work without further investment in expensive books. It is a desirable accessory for any telescopic outfit. Price . . . $3.00

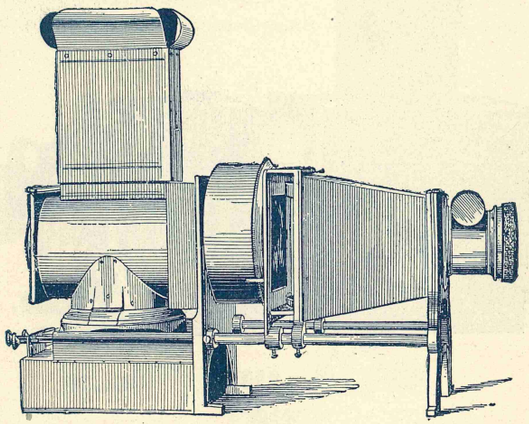
649. Poole Bros.' Celestial Planisphere 3.00

650. Poole Bros.' Celestial Note Book 2.00

N. B. — Send thirty cents for our little Note Book of Tables, Diagrams, and Useful Information. See page 24.

Lanterns for Projection.

The Manhattan Lantern.



651

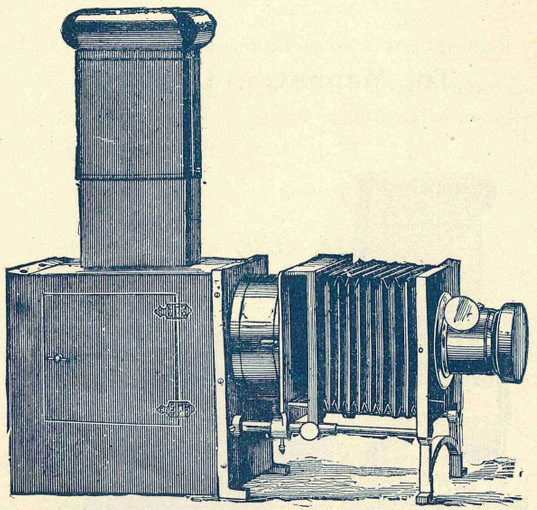
No. Price.

651. The Manhattan Lantern is especially adapted for parlor use or for small halls, and will produce a perfectly defined picture 8 ft. in diameter. Consists of a very powerful three-wick lamp, improved condensers of the finest quality, 4 ins. in diameter, and a superior quarter-size objective, nicely mounted in brass, with rack and pinion for adjustment of focus. In wooden carrying case, price $20.00

Adjustable Lantern Stand.

652. This Stand is strongly and handsomely made of black walnut, and is arranged so that the lantern can be raised to the proper height or inclined at any angle. Easily taken apart and folded into a hard-wood carrying case, 20 x 9 x 5 ins., with lock and handle. Price 7.00

The Nonpareil Sciopticon.



653

No. Price.

653. **The Nonpareil Sciopticon** is incomparably the best magic lantern ever offered for parlor, lodge, or school-room use. The skeleton frame, made of light but strong brass castings, handsomely nickel-plated, permits of a very great reduction in bulk. When not in use, and when packed in its Russian iron carrying case, it weighs but 8 lbs. The condensers are 4½ ins. in diameter and of finest quality, mounted in brass cells. It has side door and internal fittings for jets, and can be rapidly converted into a lime-light lantern at no additional expense, an advantage possessed by no other lantern in the market. This lantern is fitted with levelling screws (not represented in above illustration). Price, complete $35.00

654. **The Nonpareil Sciopticon,** fitted for use with our Hand-Feed Focussing Arc Lamp, No. 699 . . . . . 45.00

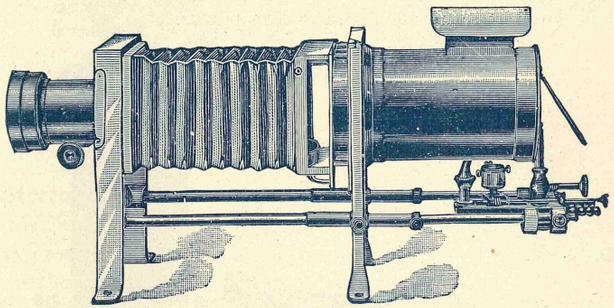
655. **Consists of a pair of Nonpareil Sciopticons,** mounted on a wooden platform, with lenses matched for dissolving views, and a Universal Dissolver, in wooden carrying case . . . 85.00

Combination Oil, Lime, and Electric Light College Lantern.

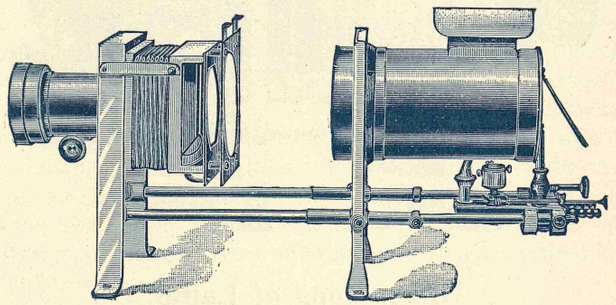
These cuts show the lime-light attachment as well as the method of extending the front of lantern from the condensing lenses for the insertion of the vertical attachment and other college apparatus. This lantern is very compact when closed, yet can be extended to admit the use of objective lenses of all sizes. It is very elegant in appearance, being full nickel-plated, which adds greatly to its durability and but little to the cost. It is made entirely of brass and white metal (no Russia iron being used), hence it will not get overheated.

The condensing lenses are 4½ ins. in diameter, plano-convex, mounted in brass cells, and can be easily removed to clean.

The objective lenses are the highest grade imported (see note, bottom of page), and are achromatic.



656



657

No. Price.

656. **Price,** including No. 1 objective lens, with lime-light burner . $68.00

657. **Price,** „ „ 3 „ „ „ „ „ . . 80.00

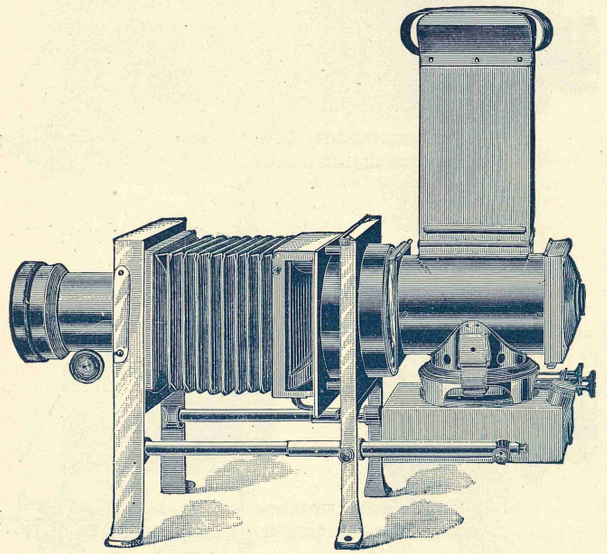
NOTE. — Objective No. 1 measures 1⅝ ins. in diameter, has focus of 4½ ins., and shows 7 ft. disc at 15 ft. Objective No. 3 measures 2¼ ins. in diameter, has focus of 7 ins., and shows 18 ft. disc at 60 ft.

Ideal Lantern with Quadruplex Oil Lamp.

Every exhibitor will hail with delight the advent of this new Oil Lamp, shown attached to Ideal Lantern in illustration below, for it can be used to advantage in many instances in place of the oxyhydrogen light, and in combination with our objective and condensing lenses of superior quality will illuminate a clear and well-defined picture 12 to 15 ft. in diameter.

The lamp is constructed on scientific principles, the main feature being the peculiar arrangement of the wicks, which are so placed as to allow a current of air to pass upward and between the flames, producing perfect combustion and absolute concentration of light.

The wick chambers are elevated from the oil reservoir sufficiently to keep the latter from becoming heated. The lamp is fitted with silver-plated conical reflector and telescopic chimney; running capacity, two hours. This lamp has been tried side by side with five of the best-selling American and English lamps, and we are satisfied that no lamp can approach it in candle power.



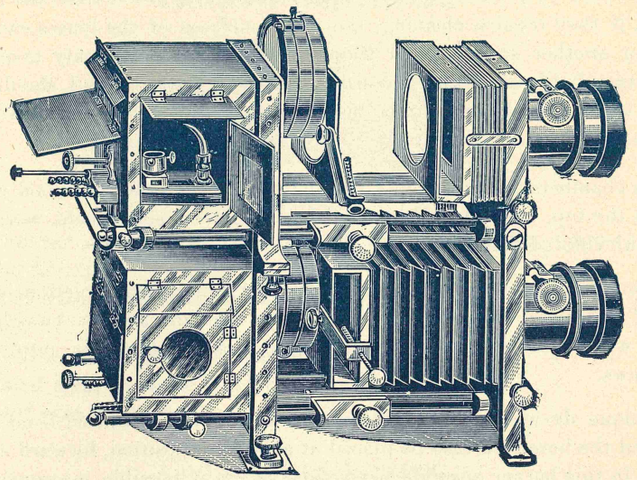
658

Dimensions of Lamp.

Length	6 ins.
Width	4¼ „
Height from base to center of flame	5 „
Height from base to bottom of chimney	7½ „

No.		Price.
658.	**Price, Ideal Lantern,** including Quadruplex Oil Lamp, No. 1 objective, improved sliding carrier and case	$60.00

The Improved "Boston Ideal" College Stereopticon.



659

No.

659. **This Stereopticon** is the result of years of study and practical experience in this line. The instrument is constructed on scientific principles, and every possible improvement has been added which will facilitate the operator in the management and control of the lanterns.

These lanterns are made of metal, handsomely nickel-plated, and are mounted one above the other, the upper lantern being pivoted to the lower at the front standards; and, by the use of improved regulating wheels, the rear of upper lantern can be elevated to secure the necessary vertical registration. The horizontal registration is obtained by the use of wheels placed at the sides of lanterns, and they are so arranged that by the turn of a thumb-screw they can be dropped out of position to admit long mechanical slides to carriers, and without interfering with the perfect registration of all other slides. The slide holder of the upper lantern, being detachable at the face of the condensing lens, can be moved forward and fastened to the front standards, thus allowing a clear space for the vertical attachment, and such other paraphernalia as are used in colleges for scientific and experimental work.

The standards or main supports are made sufficiently heavy to insure the lanterns being perfectly rigid, and no vibration is perceptible on the screen when the slides are inserted.

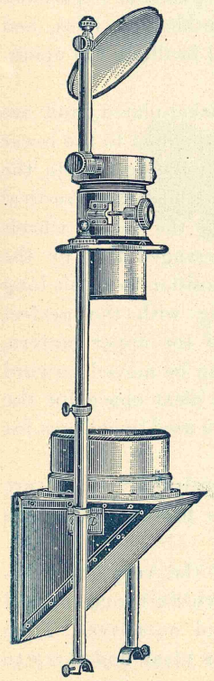
The Objective Lenses used in this instrument are the very finest imported, being made expressly to order by a well-known Paris maker; and they have the double guarantee of the manufacturer and ourselves. They are perfectly achromatic, and will define the pictures clear and sharp to the edges.

The Condensing Lenses are the best French crystal glass, plano-convex, 4½ ins. in diameter. They are mounted in a unique manner, in hinged brass cells, and are so arranged that by pressing a knob they can be easily lifted from the lanterns (see cut); and, if they require cleaning, the inner surfaces of the lenses can be reached by pressing another spring, when the mountings can be quickly taken apart. A metallic flange holds the back condensing lenses in position, and should one break during a lecture, a new one can be instantly inserted. All operators will appreciate this device, and it is the only lantern in the market so arranged.

The gas chambers are thoroughly ventilated on three sides, are lined with asbestos packing at the top, and have neatly finished doors on either side, with peep-holes covered with colored glass.

The burners are constructed in such a manner that all manipulation is done from outside of lanterns. For instance, they move forward and backward on parallel rods, and when the focus has been secured they are fastened in position by small thumb-screws.

By a unique device the limes are raised, lowered, and turned from the rear of lantern, and the limes can also be placed at any given position, forward or backward. We claim in this burner *absolute perfection*, as every possible movement is accomplished in a most easy manner and without danger of burning the hands.



662

The lanterns when not in use can be folded together very compactly, having collapsible bellows, and after being packed in a small case can be easily carried in the hand, thus *saving all transportation and the breakage which is sure to follow.*

We claim absolute perfection in this instrument, it having many patented improvements which will not be found on lanterns of other manufacture.

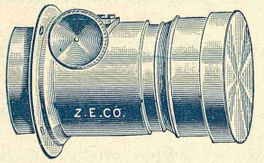
No.		Price.
660.	**Price,** including No. 1 objective lenses, high pressure key No. 1, and all connections, complete in carrying case . . .	$185.00
661.	**Price,** including No. 3 objective lenses, improved high pressure key and all connections, complete in carrying case . .	235.00

Vertical Attachment.

662.	**This attachment** is made to fit the Ideal College Lantern, but can be constructed to attach to any optical lantern. Price .	50.00

Miscellaneous Accessories for Projection.

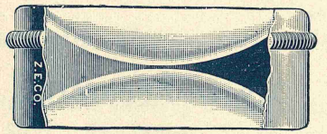
Lantern Objectives.



663-667

No.		Price.
663.	**One-quarter size, lacquered brass,** double combination achromatic lenses	$4.50
664.	**One-half size, lacquered brass,** double combination achromatic lenses	9.00
665.	**One-quarter size, genuine Darlot**	6.50
666.	**One-third size, genuine Darlot**	11.00
667.	**One-half size, genuine Darlot**	13.50

Condensing Lenses.

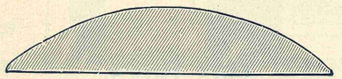


668-670

668.	**Pair Plano-convex Condensers,** mounted in brass cells, 4 in. diameter	5.50
669.	**Pair Plano-convex Condensers,** mounted in brass cells, 4½ in. diameter	7.25
670.	**Pair Plano-convex Condensers,** mounted in brass cells, 5 in. diameter	9.00

Condensing Lenses.

Unmounted.

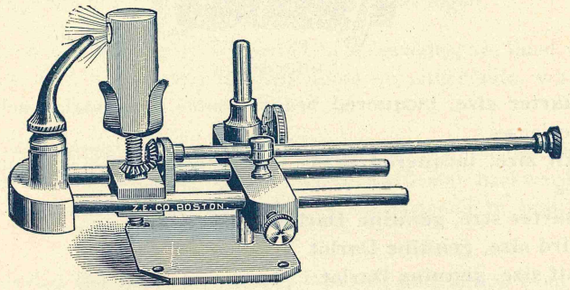


671-677

671.	**Condensing Lenses,** plano-convex, 2½ in. diameter, 2 in. focus	.65
672.	**Condensing Lenses,** „ 3 „ „ 5 „ „	.95
673.	**Condensing Lenses,** „ 3½ „ „ 5 „ „	1.80
674.	**Condensing Lenses,** „ 4 „ „ 6 „ „	2.25
675.	**Condensing Lenses,** „ 4½ „ „ 6½ „ „	2.80
676.	**Condensing Lenses,** „ 5 „ „ 7 „ „	3.75
677.	**Condensing Lenses,** „ 6 „ „ 7½ „ „	5.50

No.		Price.
678.	**Microscope Attachment for Lanterns,** with objectives	$27.00
679.	**Microscope Attachment for Lanterns,** without objectives	18.00

Improved Calcium Light Jets.



680

680.	**Improved Jet,** with stop-cocks and gearing for raising, lowering, and turning limes	11.00

Oxygen Apparatus.

681.	**Consisting of Heavy Copper Retort,** with stand and Argand Spirit Lamp, glass purifier, india-rubber connections, canvas-lined gas bag, 30 x 40 x 20 ins., 55 gallons capacity, with brass stop-cock. Price	30.00

Hydrogen Apparatus.

682.	**Consisting of Heavy Copper Generator,** glass purifier, india-rubber connections, canvas-lined gas bag, 30 x 40 x 20 ins., 55 gallons capacity, with brass stop-cock. Price	30.00

Gas Bags.

683.	**Extra Quality,** canvas lined on both inner and outer surfaces, and very durable. Will stand any climate. Canvas-lined gas bag, 30 ins. wide, 40 ins. long, 20 in. gusset, 55 gallons capacity, with stop-cock at large end	18.00
684.	**Best Limes,** in tin canister, with screw top, per dozen	1.20
685.	**Flat, Circular Limes,** per dozen	2.10

No.		Price.
686.	**One charge Chemicals,** for making oxygen, ready mixed, per package	$ .50
687.	**Lecturer's Reading Lamp,** with signal light and bell	3.00
688.	**Tanks,** 4 x 7 ins., for exhibiting fish, insect, and chemical experiments, each	3.25
689.	**Thin Crystal Glass,** for views, 3¼ x 4 ins., per dozen	.40
690.	**Black Paper Mats,** for mounting views, 3¼ x 4 ins., per dozen, 25 cts.; per 100	1.00
691.	**Black Binding Strips,** 3¼ x 4 ins.	.25

Screens.

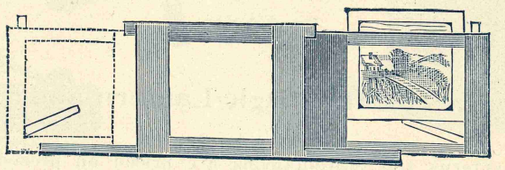
692. **First Quality,** with loops.

Sizes:	7½	9	12	15	18	24 ft. square.
	$2.25	$3.50	$6.00	$9.00	$11.00	$16.00 each.

Adjustable Extension Poles.

693.	**These poles** have three joints and may be lengthened to any desired length up to 30 ft. The screen can be firmly supported by them without fastening screw-eyes in the walls. They are very portable, and are very extensively used by first-class lecturers. Price, per pair	10.00

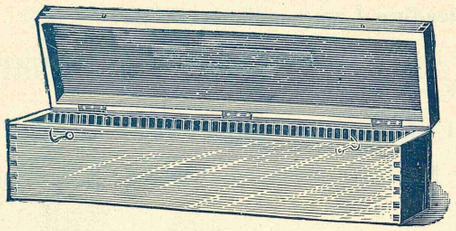
New Self-Centering Carrier for Single Lantern.



694

694.	**Made of cedar wood,** well seasoned. This carrier is adapted for any single lantern, and once placed in position does not require to be changed or taken out of the lantern for the introduction of slides. It is fitted with metallic pieces at either end for forcing the slide out of the carrier, without placing the fingers on the slides. Price, each	1.00

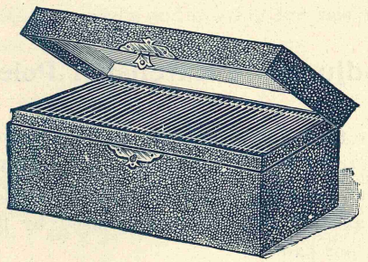
Wood Boxes.



695

No.		Price.
695.	**For holding 50 slides**	$1.00
696.	**For holding 60 slides**	1.25

New Style Wood Boxes.



697

697. **Covered with heavy black linen,** and fitted with sliding partitions; very neat in appearance. Price, for box holding 50 slides 1.00

Views or Slides for the Magic Lantern and Stereopticon.

The Magic Lanterns and Stereopticons are priced on preceding pages without views.

We shall not attempt to list any slides in this catalogue.

If parties contemplating the purchase of slides will send to us a list of the subjects which they wish to represent, we shall be pleased to send them selected lists of slides for such subjects, and also to quote prices.

We can furnish, at short notice, views illustrating every subject of popular interest, and at very low prices.

New Type of Hand-feed Focussing Arc Lamp, with Rheostat,

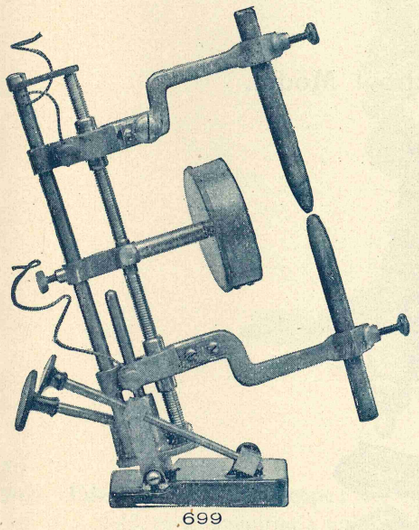
Our Own Manufacture,

For Projection and Demonstration Purposes.

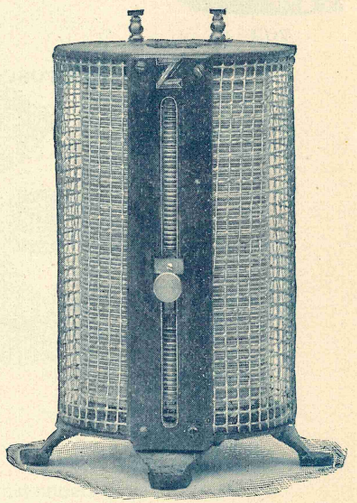
In this lamp, we believe we have overcome the objections to, and eliminated the weak points of, this type of apparatus. The lamp is constructed for use on continuous and alternating currents with voltages from 50 to 110. This lamp is not complicated nor liable to get out of order. It is easily managed, burns with a clear, steady light, and is noiseless.

The carbons are fed (both at the same time) by turning the left-hand milled wheel at the base of the lamp. It requires very little attention. By means of the right-hand wheel, the lamp can be adjusted to any angle, and the position of the arc raised or lowered.

We also furnish with the lamp an adjustable rheostat, with which the candle power obtainable from the lamp may be regulated by increasing or decreasing the current. The lamp can be used in connection with any single lantern where the center of the condensing lenses has any elevation within reasonable limits.



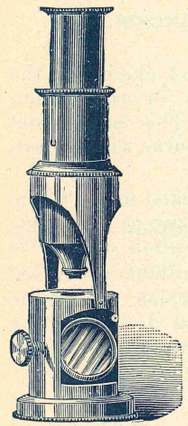
699



700

No.		Price.
698.	**Continuous and Alternating Current Lamp,** as above described, nickel-plated, with rheostat	$20.00
699.	**Continuous and Alternating Current Lamp,** as above described, nickel-plated, without rheostat	16.00
700.	**Rheostat alone**	5.00
701.	**Style P.** Larger Rheostat, more extended range, built with porcelain support, for continuous or alternating current, very desirable	12.00

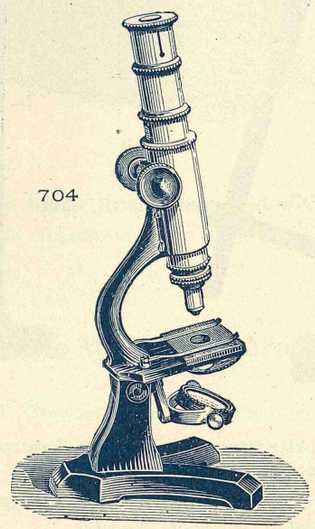
Compound Microscopes.



702

No.		Price.
702.	**Microscope (French), Compound,** 6 ins. in height, with tubular lacquered brass stand, simple objective and one eye-piece, affording power of 40 diameters; including one prepared object, two glass slips, and a pair of brass forceps; in polished mahogany box .	$3.50
703.	**Microscope (French), Compound,** 7 ins. in height, simple objective and one eye-piece, affording power of 50 diameters; including one prepared object, two glass slips, and a pair of brass forceps, in neat polished mahogany box	4.00

Microscope, School Model.

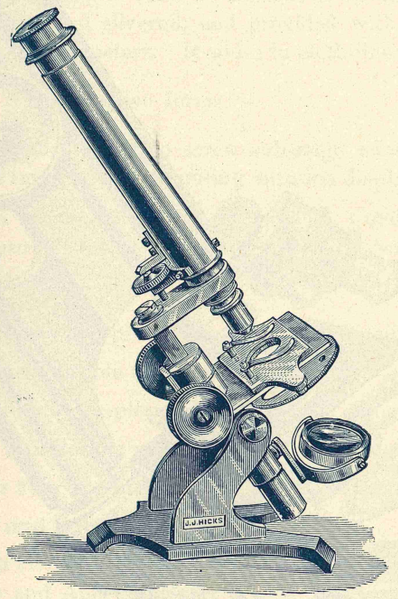


704

No.		
704.	**Price,** complete, with eye-piece and $\frac{1}{4}$ in. dividing objective, magnifying from 100 to about 350 diameters, in polished mahogany case	18.00

We recommend this instrument to schools, teachers, students, and others who desire to secure the maximum power and efficiency at the minimum of expense. Its exceedingly low price brings it within the reach of all. We believe no microscope on the market offers so much for the money. The London Society screw is used, so that higher or lower powers may be added at any time without inconvenience. As will be shown by the engraving, it is built after the most approved design.

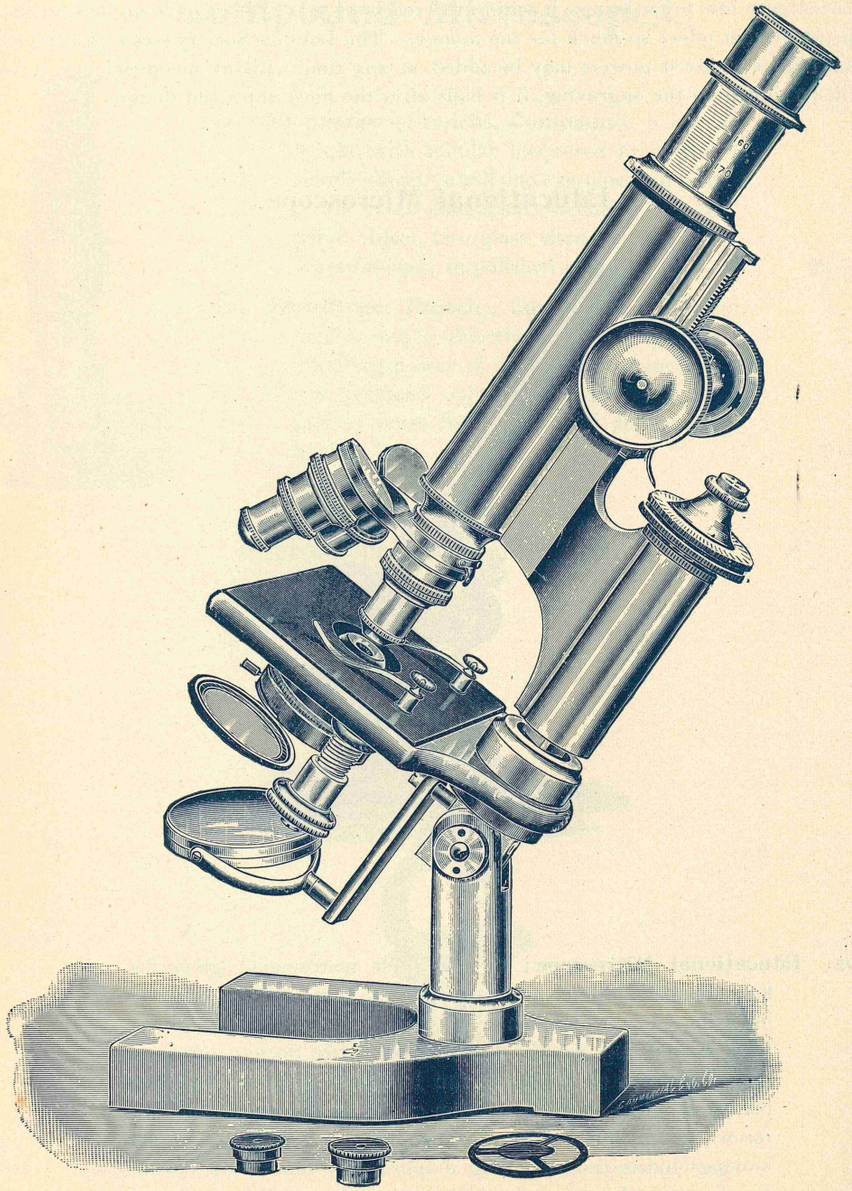
Educational Microscope.



705

No.		Price.
705.	**Educational Microscope;** an admirable instrument; gives flat field, clear definition; quite achromatic; three object-glasses (1 in., $\frac{1}{2}$ in., $\frac{1}{4}$ in.), which can be used singly or all together, giving high magnifying power; has thread of the Society screw, so that objectives of any make can be used; body turns on two pivots, so as to suit the position of the head; coarse and fine screws permit quick or slow adjustments; has sliding stage for moving objects and revolving diaphragm. The whole, including dissecting forceps, animalcule cage, and condenser, in a neat mahogany case, with handle, lock, and key; very cheap at .	$30.00

Continental Microscope — BB and BBS.



BB 8

(Cut one-half of actual size.)

Continental Microscope — BB and BBS.

This instrument (shown in opposite illustration) is made of brass throughout, highly polished and lacquered. The corners are rounded. The base is of large size and leaded, thus giving extreme stability at any angle of inclination. The stage is very large, with hard rubber plate vulcanized into its upper surface, to prevent warping. The sub-stage is adjustable by quick-acting, delicate screw-motion, and may be swung to one side when not in use. The mirrors are plane and concave and of large size. The mirror bar has a stop in the optical axis. Coarse adjustment is by diagonal rack and pinion. Fine adjustment is by micrometer screw, the head of which is graduated and silvered, and provided with an indicator. The draw tube is graduated into millimeters. It slides in cloth-lined sleeve of main tube.

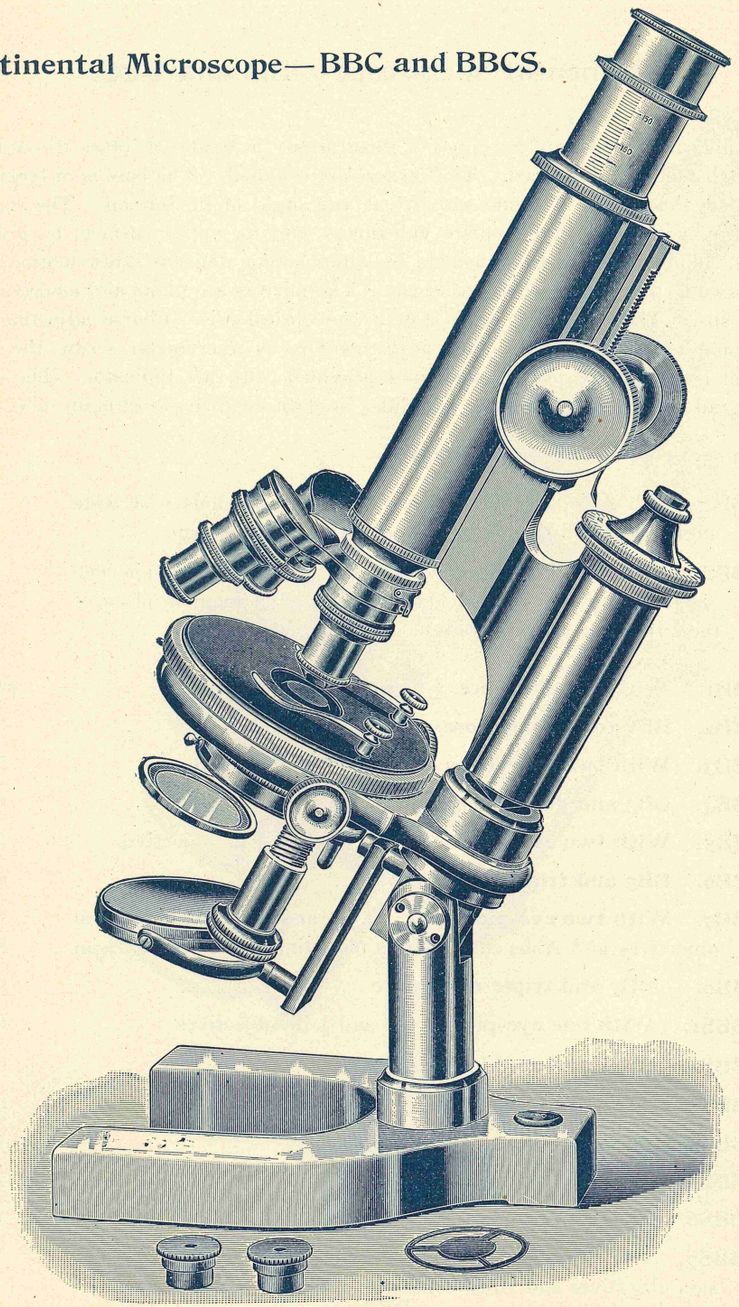
This microscope is made in two forms: —

BB. With Abbe adjustable screw sub-stage condenser of wide angle and small size, in mounting with iris diaphragm.

BBS. With Abbe Achromatic I. O. N. A. Condenser, pin-hole cap, and provided with rack and pinion adjustment in place of the adjustable screw sub-stage.

No.			Price.
706.	BB1.	**With one eye-piece,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	$48.00
707.	BB2.	**BB1 and double nose-piece**	53.00
708.	BB3.	**With two eye-pieces,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	50.00
709.	BB4.	**BB3 and double nose-piece**	55.00
710.	BB5.	**With two eye-pieces,** 2 in., $\frac{2}{3}$ in., and $\frac{1}{6}$ in. objectives	56.00
711.	BB6.	**BB5 and triple nose-piece**	63.50
712.	BB7.	**With two eye-pieces,** $\frac{2}{3}$ in., $\frac{1}{6}$ in., and $\frac{1}{12}$ in. oil immersion objectives and Abbe condenser in mounting with iris diaphragm	87.50
713.	BB8.	**BB7 and triple nose-piece**	95.00
714.	BBS1.	**With one eye-piece,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	63.00
715.	BBS2.	**BBS1 and double nose-piece**	68.00
716.	BBS3.	**With two eye-pieces,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	65.00
717.	BBS4.	**BBS3 and double nose-piece**	70.00
718.	BBS5.	**With two eye-pieces,** 2 in., $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	71.00
719.	BBS6.	**BBS5 and triple nose-piece**	78.50
720.	BBS7.	**With two eye-pieces,** $\frac{2}{3}$ in., $\frac{1}{6}$ in., and $\frac{1}{12}$ in. oil immersion objectives and Abbe condenser	102.50
721.	BBS8.	**BBS7 and triple nose-piece**	110.00

Continental Microscope—BBC and BBCS.



BBC 8

(Cut one-half of actual size.)

Continental Microscope—BBC and BBCS.

This microscope (shown in opposite illustration) corresponds with the BB in all respects, with the following exceptions: the jointed pillar is made somewhat higher to admit of the attachment of the complete sub-stage attachment, as used in the BBS.

The stage is revolvable with hard rubber surface, and rests upon a strong stage plate, which is provided with centering screws. These are used for obtaining exact coincidence with the optical axis, and with narrow limits give a mechanical movement for the object.

This microscope is made in two forms:—

BBC. With adjustable screw sub-stage, as in BB.

BBCS. With complete sub-stage attachment, as in BBS, provided with rack and pinion adjustment in place of adjustable screw sub-stage.

No.		Price.
722.	**BBC1. With one eye-piece,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	$65.00
723.	**BBC2. BBC2 and double nose-piece**	70.00
724.	**BBC3. With two eye-pieces,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	67.00
725.	**BBC4. BBC3 and double nose-piece**	72.00
726.	**BBC5. With two eye-pieces,** 2 in., $\frac{2}{3}$ in., and $\frac{1}{6}$ in. objectives	73.00
727.	**BBC6. BBC5 and triple nose-piece**	80.50
728.	**BBC7. With two eye-pieces,** $\frac{2}{3}$ in., $\frac{1}{6}$ in., and $\frac{1}{12}$ in. oil immersion objectives and Abbe condenser in mounting with iris diaphragm	112.50
729.	**BBC8. BBC7 and triple nose-piece**	120.00
730.	**BBCS1. With one eye-piece,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	80.00
731.	**BBCS2. BBCS1 and double nose-piece**	85.00
732.	**BBCS3. With two eye-pieces,** $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives	82.00
733.	**BBCS4. BBCS3 and double nose-piece**	87.00
734.	**BBCS5. With two eye-pieces,** 2 in., $\frac{2}{3}$ in., and $\frac{1}{6}$ in. objectives	88.00
735.	**BBCS6. BBCS5 and triple nose-piece**	95.50
736.	**BBCS7. With two eye-pieces,** $\frac{2}{3}$ in., $\frac{1}{6}$ in., and $\frac{1}{12}$ in. oil immersion objectives and Abbe condenser	126.00
737.	**BBCS8. BBCS7 and triple nose-piece**	133.00

Simple Pocket Dissecting Microscope.

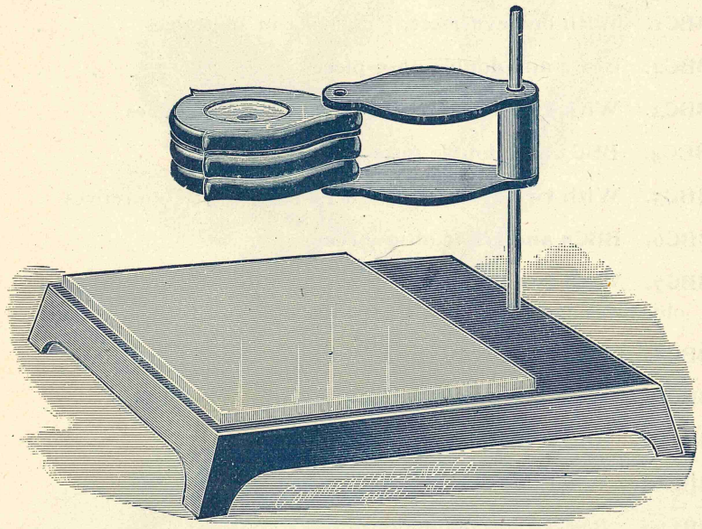
This microscope (shown below) is very convenient for examination of minerals, insects, flowers, etc.

It consists of an iron base with glass plate inlaid, forming a white background. A steel stem is screwed into the base plate, to which the magnifier is fitted and arranged to slide. The magnifiers are furnished with one, two, or three lenses, which give a magnifying power of from 5 to 25 diameters. Those with two or three lenses are provided with a diaphragm which secures distinctness of definition.

The stem can be easily unscrewed, and the whole packed in a small box.

With each instrument a pair of nickel-plated pliers is furnished.

No.		Price.
738.	**Dissecting Microscope,** with one lens	$1.25
739.	**Dissecting Microscope,** with two lenses	1.50



740

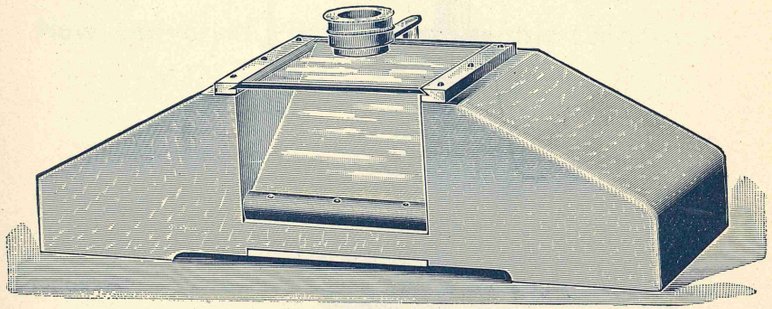
(Cut full size.)

740.	**Dissecting Microscope,** with three lenses	2.00
741.	**Dissecting Microscope,** with three lenses, magnifier not in folding case, as shown	1.25

Primary Dissecting Microscope.

This microscope (shown below) is very extensively used by students in the laboratories of high schools and colleges. It meets the demand for an effective, convenient, and low-priced instrument, combining simplicity and solidity.

The body is a block of wood so shaped that the sides serve the purpose of hand-rests; mirror and glass stage plate are provided for in a simple manner. A square rubber plate is supplied with this instrument, having on one side a white, and on the other a black surface for dark ground illumination; the block has a receptacle for this plate when not in use. The lens is vertically adjustable for focus.



742

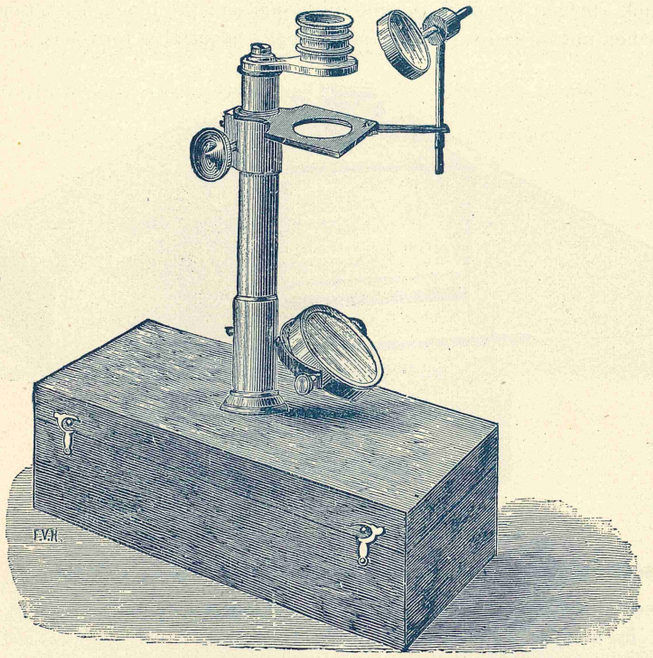
(Cut one-third actual size.)

No.		Price.
742.	**Dissecting Microscope,** with single lens, as above	$2.50
743.	**Dissecting Microscope,** with two mounted lenses of 2 in. and 1 in. focus	3.50
744.	**Single Lenses,** mounted, of $\frac{3}{4}$ in. or $\frac{1}{4}$ in. focus, extra; each .	1.00

The School Microscope.

This instrument (shown on page 118), consists of a tubular stem about 5 ins. high, the lower end of which screws firmly into the lid of the box wherein the instrument is packed when not in use. To the upper end of this stem the stage is firmly fixed, while the lower end carries a concave mirror. Within the tubular stem is a round pillar, having a rack cut into it, against which a pinion works that is turned by a milled head; and the upper part of this pillar carries a horizontal arm which bears the lenses, so that by turning the milled head the arm may be raised or lowered, and the requisite focal adjustment obtained. Three magnifiers are supplied; and by using

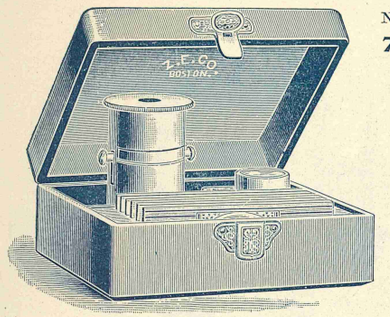
them, either separately or in combination, a considerable range of powers, from about 5 to 40 diameters, is obtained. A condensing lens for opaque objects, and an aquatic box for the examination of objects in water, are also supplied. This instrument is peculiarly adapted for educational purposes, being fitted in every particular for the examination of botanical specimens, small insects or parts of insects, water fleas, the larger animalcules, and other such objects as young people may readily collect and examine for themselves; and those who have trained themselves in the application of it to the study of nature are well prepared for the advantageous use of the Compound Microscope.



745

No.		Price.
745.	**The School Microscope,** complete as above	$6.00
746.	**The Child's Microscope,** similarly mounted to the preceding, but without condensing lens and rack adjustment, with live-box, brass forceps, watch-glass, two glass slips, and one prepared object	5.00
747.	**Educational Dissecting Microscope,** similar to No. 590, but without condensing lens, mounted on a neat japanned iron base. Price, including microscope, live-box, brass forceps, watch-glass, two glass slips, and one prepared object, all packed in neat mahogany polished box	5.00

Universal Microscope.



748

No.		Price.
748.	**Price,** complete, with three prepared microscopic objects, three glass slips, and aquatic box for the examination of objects in water, in neat box	$1.50

The portability, low price, and the facility with which it can be used recommend this instrument very strongly. It is extremely efficient for the examination of microscopic objects, botanical specimens, insects, flowers, etc., and has a magnifying power of 50 diameters.

New Universal Photo-Micrographic Camera.

749

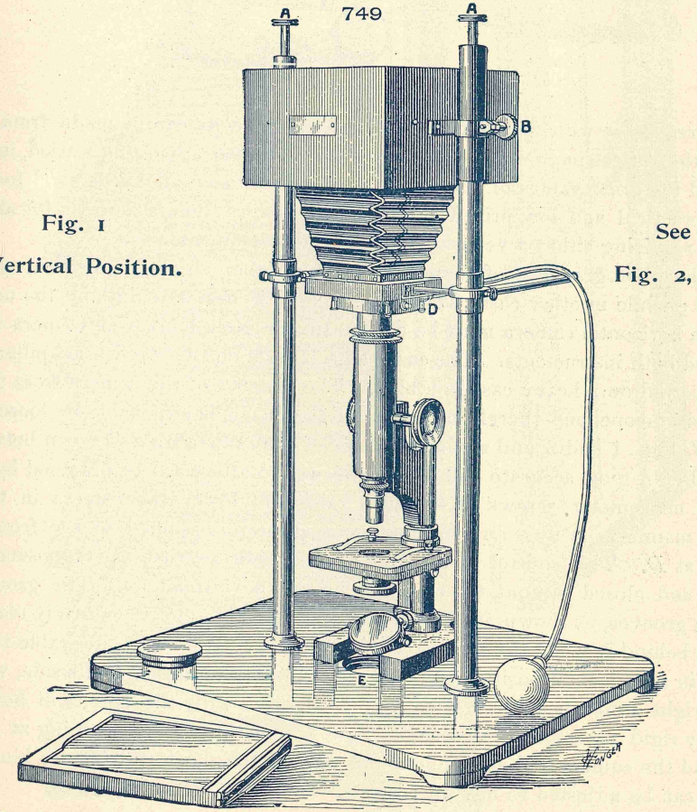


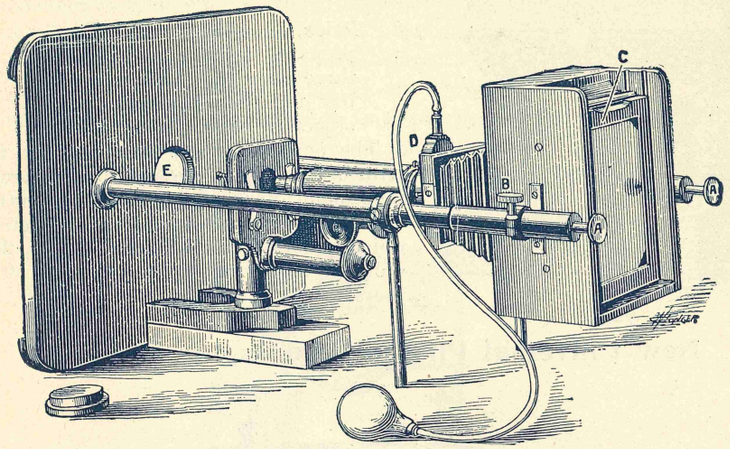
Fig. 1

In Vertical Position.

See also Fig. 2, p. 120.

The New Universal Photo-Micrographic Camera can be used either as a vertical or horizontal camera combined. Micrometer adjustments for focussing. Accurate time shutter for regulating length of exposure without jar to the camera. Can be used with any microscope. The only first-class Photo-Micro-Camera at a moderate price.

Fig. 2. In Horizontal Position.



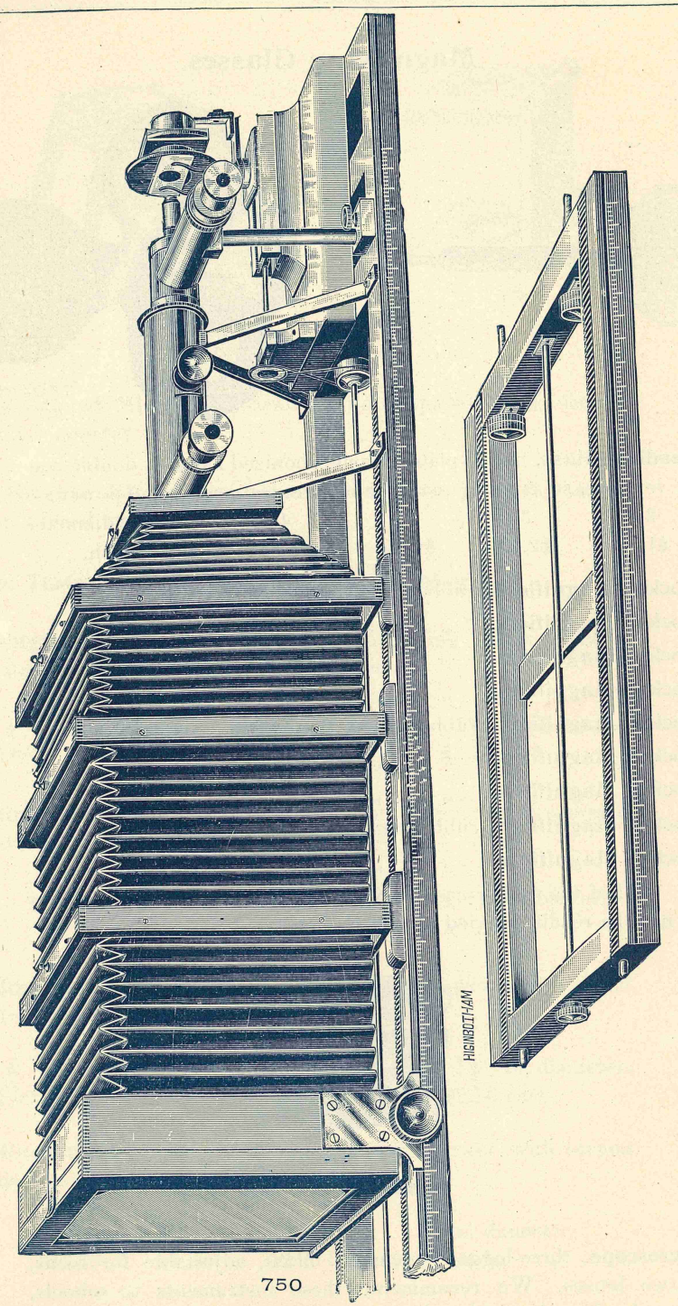
749

The great ease with which a Photo-Micrographic copy can be made from minute objects, the entire simplicity of the process where proper apparatus is used, its cheapness, and the great values of the results obtained, have created a demand for a thoroughly practical and low-priced Photo-Micrographic Camera suitable for all classes of work requiring either a vertical or horizontal instrument.

For the photographing of liquids, and many other objects, a vertical camera is essential; while in other cases where direct light is desirable without the use of the mirror, a horizontal camera must be used. In our New Universal Camera we have combined both instruments. The camera itself rests on two rigid brass pillars, which are supported on a heavy cast-iron base. The distance of the camera from the stage of the microscope, and therefore the size of the image, is adjustable by loosening the screw *B*, Figs. 1 and 2, and sliding the tops of the camera up and down between the standards. A most accurate and delicate focus can afterward be obtained by turning the two micrometer screws *AA*, which raise and lower the camera in the most delicate manner. A time and instantaneous shutter is applied to the front of the camera at *D*. This shutter is controlled by a bulb so that the exposure can be opened and closed without the slightest jar to the instrument. The ground-glass slides in grooves, as shown at *C*, in Fig. 2, and the plate-holder is firmly clamped in position behind it while the picture is being taken. When it is desirable to use the camera in a horizontal position, it is simply necessary to rest it on its side, when the two upright supports, as shown in Fig. 2, together with the base, will hold it in a perfectly rigid manner. The beam of light is sent through the opening at *E* in the base, and the camera is then a horizontal one of the most satisfactory kind. This camera can be adjusted to any microscope.

No. Price.

749. Universal Photo-Micrographic Camera, without microscope, but complete in every way, with ground glass, double 4 x 5 plate-holder, time and instantaneous shutter $35.00

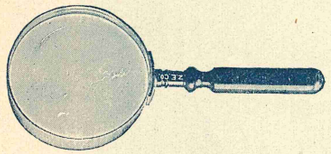


750

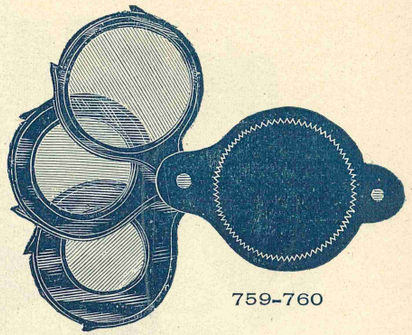
No. Price.

750. Professional Photo-micro Camera, with tapering bellows and one section with ground glass, posterior and anterior rectangular tubes, one frame section, complete adjustments, one 6½ x 8½ plate-holder, one achromatic amplifier $115.00

Magnifying Glasses.



751



759-760

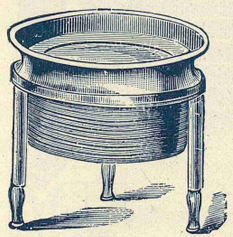
No. Price.

751. **Reading Glass,** nickel-plated frame, ebonized handle; double convex lens, superior in quality, and of extra magnifying power:—

2½	3	3½	4	4½ in. diameter.
$1.50	$2.00	$2.25	$3.00	$3.75 each.

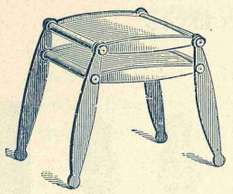
752. **Pocket Magnifiers,** rubber cased, single lens, ¾ in. . . . $ .25
753. **Pocket Magnifiers,** „ „ „ „ 1 „ 35
754. **Pocket Magnifiers,** „ „ „ „ 1¼ „ 45
755. **Pocket Magnifiers,** „ „ „ „ 1½ „ 60
756. **Pocket Magnifiers,** rubber cased, two lenses, ⅝ and ¾ in. . .45
757. **Pocket Magnifiers,** „ „ „ „ ⅞ „ 1 „ . .60
758. **Pocket Magnifiers,** „ „ „ „ 1⅛ „ 1¼ „ . .80
759. **Pocket Magnifiers,** rubber cased, three lenses, ⅝, ¾, and ⅞ in. . .75
760. **Pocket Magnifiers,** „ „ „ „ ¾, ⅞, „ 1 „ . .95

All of the rubber-cased magnifiers fold inward, so that they may be readily carried in vest pocket.

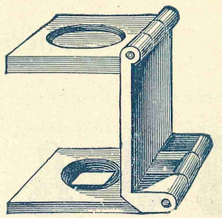


761

761. **Microscope,** three-legged, lacquered brass, adjustable for focus, two lenses. We recommend these instruments to schools, teachers, and students, as cheap though efficient magnifying lenses for botanical purposes; 1⅛ in. diameter 50



763



764

No. Price.

762. **Three-Legged Microscope,** oxidized, non-adjustable, two lenses, 1¾ in. diameter $1.25

763. **Four-Legged Microscope,** lacquered brass, two powerful lenses, 3 x 2 ins. diameter 3.75

764. **Linen Tester or Pick Glass,** brass, ½ in. opening 40

765. **Coddington Magnifier,** extra high magnifying power; nickel-plated, metal case, folding, with ring:—

½	¾	1	1⅜	1⅝ in. diameter.
$1.65	$2.00	$2.25	$3.00	$3.75 each.

766. **Coddington Magnifier,** extra high magnifying power, two-hinged covers and ring, German silver:—

⅜	⅝	⅞ in. diameter.
$2.50	$3.00	$3.50 each.

767. **Coddington Magnifier,** extra high magnifying power, with twisted wire handle, nickel-plated:—

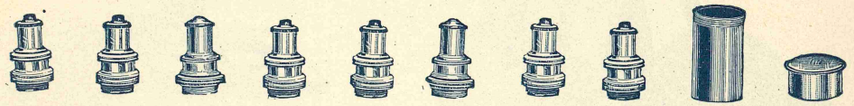
½	¾	1	1⅜	1⅝ in. diameter.
$1.00	$1.15	$1.50	$2.00	$2.75 each.

768. **Coddington Magnifier,** extra high magnifying power, with turned handle and milled caps, nickel-plated:—

⅝	1	1⅜	1⅝ in. diameter.
$1.65	$1.80	$2.25	$2.80 each.

Special quotations furnished on any of the above magnifiers in large quantities.

Microscope Objectives.



769-771

Moderate Angular Aperture.

No.							
769.	**Focal length:**	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{10}$ in.
		$8.00	$9.00	$11.00	$12.50	$15.50	$19.00

Wide Angular Aperture.

No.				Price.
770.	**Focal length:**	1	2 in.	
		$8.00	$9.50	

771. **New Pecroptic** $\frac{1}{12}$ in. oil immersion objective, the equal of the most expensive on the market $25.00

Standard Objectives.

We are also prepared to furnish, at very low prices, any of the first-class achromatic objectives offered by celebrated foreign or domestic manufacturers.

Parties intending to purchase are kindly requested to communicate with us.

Fine Microscope Objects.

No.

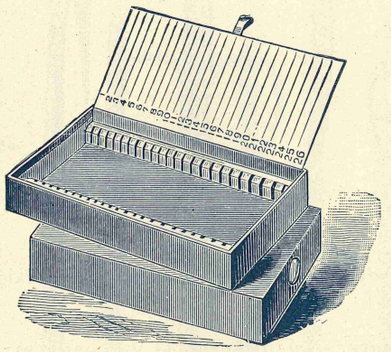
772. **Mounted upon slides,** 3 x 1 in., including portions of animals, insects, vegetables, minerals, diatoms, etc. From 25 cts. each upwards.

Educational Objects.

To meet the wants of schools and amateurs, we are preparing to furnish a series of cheap, well-mounted, interesting, and instructive objects, which we will select with special reference to subjects desired by purchaser.

No.		Price.
773.	**On slips** $2\frac{3}{8}$ x $\frac{3}{4}$ in., each	$ .15
774.	**On slips** $2\frac{3}{8}$ x $\frac{3}{4}$ „ per doz.	1.25
775.	**On slips** 3 x 1 „ each	.25
776.	**On slips** 3 x 1 „ per doz.	2.50

Box for Objects.



777

777. **Cloth-covered sliding box,** to hold twenty-five objects, of stout cardboard, with lid and sliding cover, having ruled and numbered index printed on fine linen paper on inside of lid. It is covered with dark green bookbinders' cloth, and is made in the neatest and most substantial manner 35

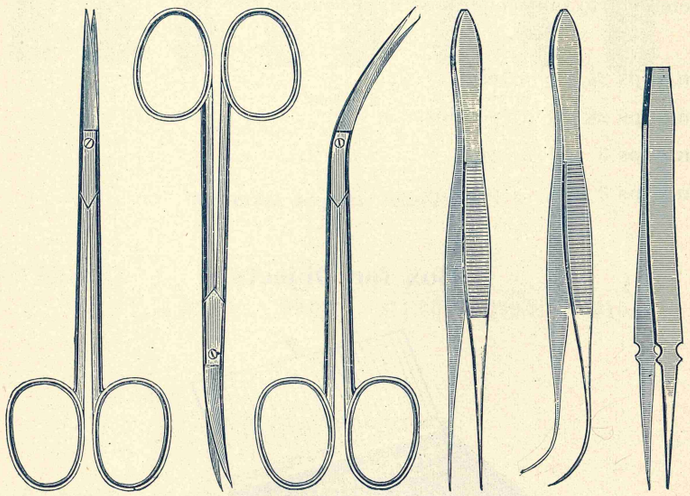
Thin Japanese Paper.

778. **In packages** of 100 sheets, $7\frac{1}{2}$ x 11 ins. 25

779. **In packages** „ 100 „ 11 x 15 „ 45

This paper has only recently been placed upon the market, and is well suited for the purpose of cleaning objective lenses.

Dissecting Instruments.

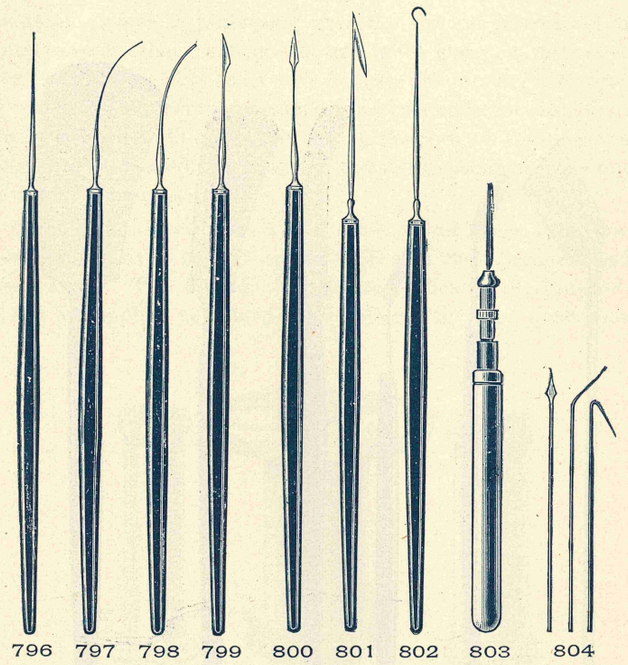


780 781 782 783 784 785

No.		Price.
780.	**Dissecting Scissors,** steel, nickeled, 4½ ins. long, straight, delicate, each	$ .75
781.	**Dissecting Scissors,** steel, nickeled, 4½ ins. long, curved, delicate, each	.90
782.	**Dissecting Scissors,** steel, nickeled, 4½ ins. long, bent, delicate, each	.90
783.	**Forceps, Dissecting,** steel, 4½ ins. long, straight, file-cut ends, each,	.75
784.	**Forceps, Dissecting,** „ 4½ „ „ curved, „ „ „	.80
785.	**Forceps, Dissecting,** „ nickeled, 4½ ins. long, straight, file-cut ends, each	.75
786.	**Dissecting Scissors,** ivory handle, with spring, each	6.00
787.	**Dissecting Knife,** ebony handle, convex blade, with round end, each	.50
788.	**Dissecting Knife,** ebony handle, curved, sharp pointed, each	.50
789.	**Dissecting Knife,** „ „ triangular shape, on long shank, each	.50

No.		Price.
790.	**Dissecting Knife,** ebony handle, triangular shape, long blade, each	$ .50
791.	**Dissecting Scalpel,** „ „ 1 in. cutting edge of blade, „	.40
792.	**Dissecting Scalpel,** „ „ 1¼ „ „ „ „ „	.40
793.	**Dissecting Scalpel,** „ „ 1½ „ „ „ „ „	.40
794.	**Dissecting Scalpel,** „ „ 1¾ „ „ „ „ „	.40
795.	**Valentine's Knife,** for cutting sections of soft tissues, each	5.50

Dissecting Needles and Section Razors.



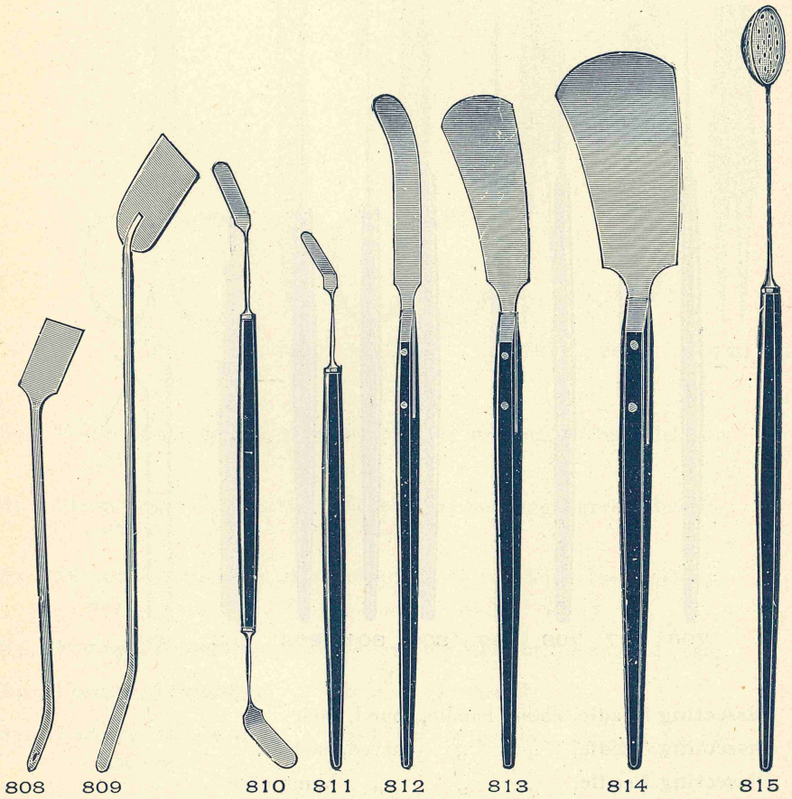
796 797 798 799 800 801 802 803 804

796.	**Dissecting Needle,** ebony handle, round, each	.40
797.	**Dissecting Needle,** „ „ curved, each	.40
798.	**Dissecting Needle,** „ „ „ blunt, each	.40
799.	**Dissecting Needle,** „ „ spear pointed, each	.45
800.	**Dissecting Needle,** „ „ triangular pointed, each	.45
801.	**Dissecting Needle,** „ „ harpoon shaped, each	.80
802.	**Dissecting Needle,** „ „ hook shaped, each	.60
803.	**Dissecting Needle Holder,** with clamp, each	.10
804.	**Dissecting Needle Holder,** with clamp and four needles, each	.15

805

No.		Price.
805.	**Dissecting Needle Holder,** with clamp, each	$ .25
806.	**Microscopic Section Razors,** plane and concave, best quality, crocus finish, cutting edge 3 ins., in pasteboard cover, each .	1.10
807.	**Microscopic Section Razors,** concave on both sides, best quality, crocus finish, cutting edge 4 ins., in pasteboard cover, each .	1.60

Section Lifters.



808 809 810 811 812 813 814 815

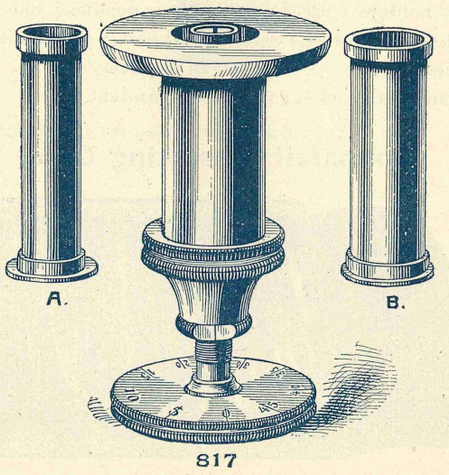
808.	**Section Lifter,** brass, nickeled, single, $\frac{5}{8}$ in. wide, each . .	.15
809.	**Section Lifter,** „ „ (better finish), single, $\frac{3}{4}$ in. wide, each	.25
810.	**Section Lifter,** brass, nickeled, ebony handle, double ended, $\frac{1}{4}$ and $\frac{3}{8}$ in. wide, each	.50

No.		Price.
811.	**Section Lifter,** brass, nickeled, ebony handle, single, $\frac{1}{8}$ in. wide, each	$ .40
812.	**Section Lifter,** „ „ „ „ $\frac{1}{2}$ in. „ „	.45
813.	**Section Lifter,** „ „ „ „ $\frac{3}{4}$ „ „ „	.50
814.	**Section Lifter,** „ „ „ „ $1\frac{1}{2}$ „ „ „	.60
815.	**Section Lifter,** „ „ „ „ spoon, perforated, „	1.00
816.	**Section Lifter,** „ „ double ended, large size, „	.75

Pasteur Microtome.

This Microtome, which is patterned after the French instrument, has many decided advantages over other hand-models, and is the cheapest instrument of its kind that has ever been offered. It has a very delicate micrometer screw with graduated head for elevating the imbedded specimen, and two different-sized cylinders, *A* and *B*, as shown in cut, which fit accurately within the core of the microtome, reducing the size of the core as desired, and allowing any sized specimen to be finely imbedded without the use of a clamp-screw.

The use of the clamp-screw, which is common to all other hand-microtomes, is a distinct disadvantage, as it compresses and distorts the specimen, and is liable to tear delicate tissues. The Pasteur Microtome is beautifully finished and nickel-plated, and can be supplied to schools and colleges in large quantities at very low rates.

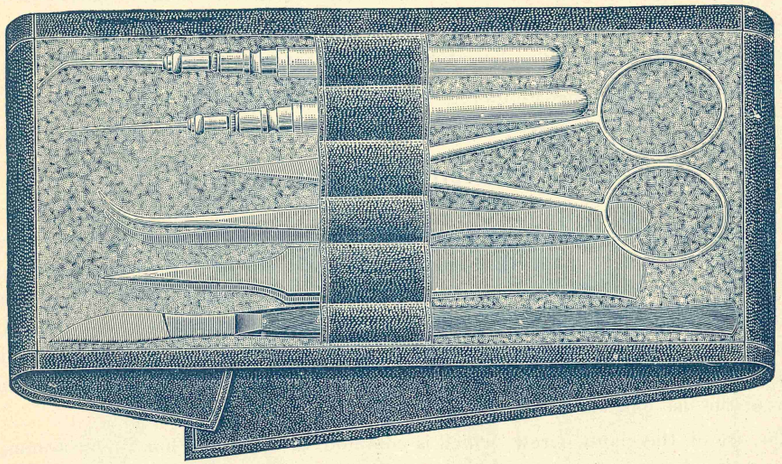


817

No.		Price.
817.	**Pasteur Microtome,** nickel-plated	$3.50

Prices on larger and more expensive microtomes, also microtome section knives, on application.

Special Set of Dissecting Instruments for Students' Use in Laboratory Work.



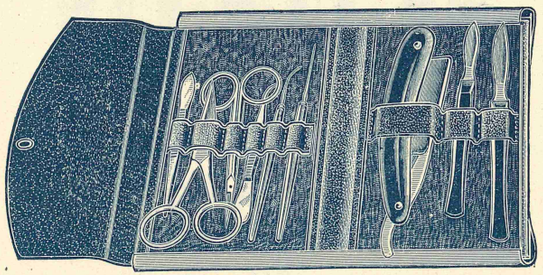
818

No. Price.

818. **Pocket Case,** finely finished leather, velvet lined, containing ebony handle scalpel, cutting edge of blade 1 in.; one pair 4½ in. straight scissors, of medium weight and good quality, delicate; two needle holders with clamp and four needles; one pair 4 in. nickel-plated steel forceps with file-cut ends; and one pair 3¾ in. curved steel forceps. Complete, as described . . . $2.75

This is an ideal pocket case for the student.

Nonpareil Dissecting Case.



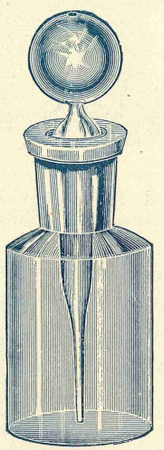
819

819. **The Nonpareil Dissecting Case,** represented in above cut, is offered as a more complete dissecting case than the preceding set, No. 818. The instruments are contained in a neat leather case, made strong and durable, and are protected, when folded,

Price.

by pieces of chamois fastened to the sides of the case. The size of the case, open, is 9½ x 7 ins. Its contents are: one section razor, of the best quality; one ebony handle scalpel, 1¼ in. cutting edge of blade; one ebony handle scalpel, 1¾ in. cutting edge of blade; one pair delicate straight scissors, of the very best quality, 4½ ins. long; one pair 4½ in. straight scissors, of good quality and medium weight; one pair straight forceps and one pair curved forceps, each 4 ins. long, of nickel-plated steel with file-cut ends; one round and one curved needle. Complete, as described $5.75

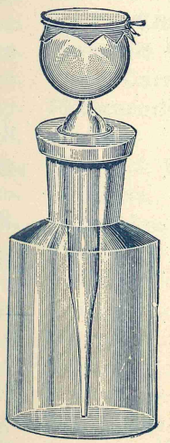
Mounting Materials.



820

No.

820. **Dropping Bottles,** with glass bulb, each 20



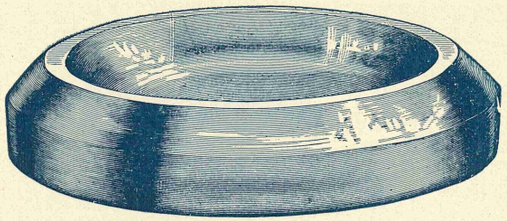
821

No.

821. **Dropping Bottles,** with rubber top, each . .25

822. **Dropping Tubes,** each 10

Watch Glasses.



823

No.		Price.
823.	**Watch Glasses,** improved form, bevelled surface, plain, not ground, per doz.	$ .65
824.	**Watch Glasses,** improved form, bevelled surface, smoothly ground, per doz.	1.20

(On this surface can be written with pencil [or pen] the name of or particulars pertaining to contents.)

This improved sliding watch glass rests solidly upon the table or microscope stage, and is not liable to be overturned and its contents spilled. In it, on the microscope stage, or over black or white paper on the table, can be examined, teased, or dissected, transparent tissues in water, alcohol, oil of cloves, or other bath.

These glasses may be piled one above the other, each becoming a cover for the one below it, so that specimens may remain in them for hours without becoming dirty, and with small loss of fluid by evaporation.

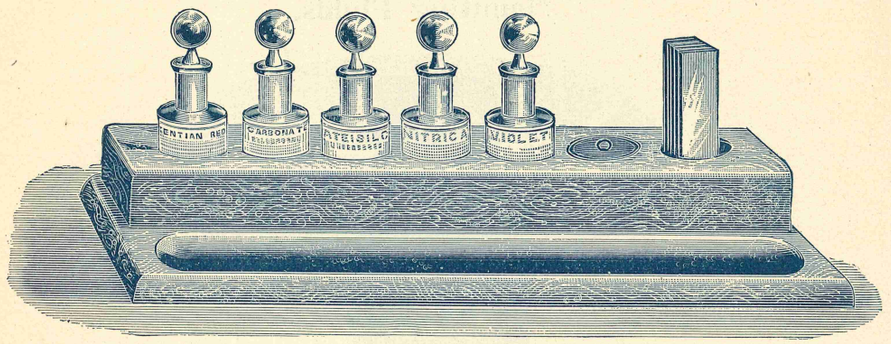
825.	**Glass Slips,** 3 x 1 in., crown cut edges, per doz.	.15
826.	**Glass Slips,** „ „ „ „ „ „ gross	1.25
827.	**Glass Slips,** „ „ „ ground edges, per doz.	.20
828.	**Glass Slips,** „ „ „ „ „ „ gross	2.00
829.	**Cover Glasses,** circles, No. 3, per doz., 20 cts.; per ½ oz.	.90
830.	**Cover Glasses,** oblong, sizes as desired, $\frac{1}{100}$ to $\frac{1}{150}$ in. thick, per oz.	.90
831.	**Atwood Rubber Cells,** for mounting opaque objects, per doz.	.35

Mounting Fluids.

844

No.		Price.
832.	**Absolute Alcohol,** Dr. Squibbs's, per bottle	$ .25
833.	**Benzole,** pure, per bottle	.20
834.	**Canada Balsam,** with chloroform, requires no heat, per bottle	.60
835.	**Canada Balsam,** paper filtered, in flexible tubes, per bottle	.25
836.	**Canada Balsam,** with Xylol, requires no heat, „	.60
837.	**Canada Balsam,** „ Benzole, „ „ „ „	.60
838.	**Damar Balsam,** „ „ „ „ „ „	.60
839.	**Glycerine,** pure, per bottle	.25
840.	**Glycerine,** camphorated, for delicate vegetable tissues, per bottle	.25
841.	**Gold Size,** per bottle	.25
842.	**Oil of Cloves,** „	.35
843.	**Brown's Transparent Rubber Cement,** per bottle	.35
844.	**Marine Glue,** fluid, per bottle	.35
845.	**Ammonia Carmine,** Beale's, per bottle	.25
846.	**Borax Carmine,** per bottle	.25
847.	**Picrocarmine,** „	.25
848.	**Eosine,** „	.20
849.	**Bismarck Brown,** „	.25
850.	**Fuchsine,** „	.35
851.	**Saffronine,** „	.35
852.	**Vesuvin,** „	.35
853.	**Aniline,** red, „	.25
854.	**Aniline,** violet, „	.25
855.	**Methyl,** blue, „	.25
856.	**Methyl,** violet, „	.25
857.	**Methyl,** green, „	.25
858.	**Hematoxylin,** „	.25
859.	**Paraffine,** for imbedding, per lb.	.30

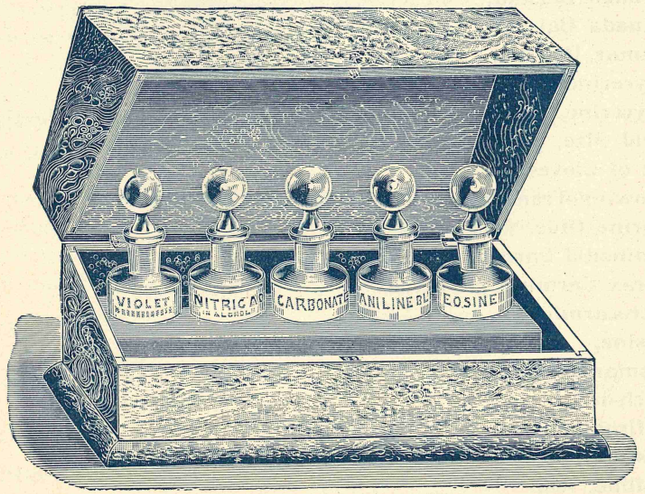
Reagent Cases.



860

No. Price.

860. **Selected block of wood** (bird's-eye maple), polished, fitted for and with five labelled reagent bottles, and receptacles for cover glass, glass slips, and groove to receive dissecting instruments; 1 oz. each of the following media, in separate bottles: Gentian Violet, Bismarck Brown, Absolute Alcohol, Turpentine, and 3 per cent. solution Nitric Acid in Alcohol. (Other media may be selected.) Each $3.00



861

861. **Reagent Case** of highly selected bird's-eye maple wood, with cover and lock, containing five labelled bottles, and arranged with receptacle for dissecting instruments. The same media as No. 860 accompany this case. (Other media may be selected.) Each 4.50

862

No. Price.

862. **Reagent Case** of highly polished selected bird's-eye maple wood, with cover and lock, containing fifteen labelled bottles, and having groove provided for knives, scissors, forceps, etc. The following media (1 oz. of each in separate bottles) accompany each case: Gentian Violet, Bismarck Brown, Fuchsine, Aniline, Methyl Blue, Eosine, Hematoxylin, 3 per cent. solution Nitric Acid in Alcohol, 3 per cent. Iodo-Iodide Potassa, 5 per cent. solution Caustic Potassa, Cedar Oil, Potassa Ferrocyanide, with 1 per cent. Acetic Acid, Absolute Alcohol, Turpentine. Each, $10.75

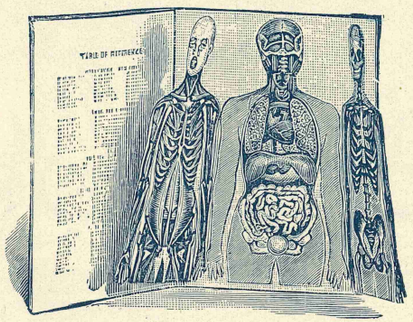
N. B. — Send thirty cents for our little Note Book of Tables, Diagrams, and Useful Information. See page 24.

Inexpensive Series

OF

Popular Anatomical Models.

Graphic Pictorial Representations by means of Superimposed Plates of the Frame and Organs, with Descriptive Texts by Noted Specialists.



REDUCED ILLUSTRATION OF MODEL OF THE HUMAN BODY, WHICH IS TEN INCHES HIGH.

863a

No.		Price.
863a.	**Model of the Human Body,** with descriptive text by Dr. Schmidt. Translated and edited by Wm. S. Furneaux	$ .75
863b.	**Model of the Human Head and Neck,** with descriptive text by Dr. Schmidt. Translated and edited by Wm. S. Furneaux .	1.00
863c.	**Model of the Human Eye,** and its auxiliary organs, anatomically represented with explanatory text by Dr. H. Renlow. Revised and edited with an introduction on eyesight, by John Browning, F. R. A. S., F. R. M. S., President of the British Optical Association. Author of "Our Eyes," etc.	1.00
863d.	**Model of Horse,** with descriptive text by A. Schwarz. Revised and edited by Geo. Fleming, F. R. C. V. S.	1.25
863e.	**Model of the Ox** . . . . . These models were designed to fill the insufficiency of ordinary diagrams for students' use, and are an improvement over many of the expensive plaster models used in teaching physiology.	1.25
863f.	**Model of a Horizontal Steam Engine,** furnished with Meyer's Variable Expansion Gear, for the use of General Readers and Elementary Engineering Students. With a brief description of the parts and the method of working, and a discussion and explanation of Leuner's Valve Diagrams, by Chr. Volkert, Engineer, Nürnberg	1.00

Charts of the Human Body.

For Instruction in Anatomy, Physiology, Hygiene, and Temperance.

The most complete set ever published at so low a price.

No.		Price.
864.	**Full set of four charts,** on cloth, with common rollers . .	$4.00
865.	**Full set,** in spring roller cases	6.75

A complete manual accompanies each set, giving not only a description of the several figures, but affording the teacher many valuable statistics and suggestions relative to anatomy, physiology, hygiene, and temperance instruction.

Anatomical Models in Papier Maché.

866. **German Make. Model of Man:** height, 87 centimeters, on 10 centimeter pedestal. Segments of chest and stomach are removable, all the viscera may be taken out; stomach, lungs, and heart opened.

The muscular layers of arms and legs are represented in three layers, the two superior ones are removable.

867. **French Make. Model of Man,** similar to above, height, 1 meter, 40 centimeters.

868. **Models of the Head,** showing half of the head, exposing the brain, throat, etc.

Any one of the above-mentioned models can be imported by us, duty free, for educational institutions. Prices on application.

Osteology.

Human Skeletons.

869.	**Human Skeletons,** articulated, with brass screws, well developed, clean, best quality, French	40.00
870.	**Human Skeleton,** articulated, with brass screws, well developed and clean, good quality	30.00

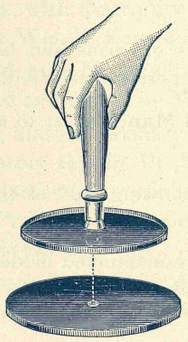
Electricity and Magnetism.

[*The days of making a plaything of electricity are past. Put money into galvanometers, resistance-coils, and articles of utility, rather than into electrical toys, such as the larger portion of frictional apparatus.*]

Electrostatics.

Instruments for exhibiting the principles of frictional electricity, induction, and distribution.

No.		Price.
871.	**Friction Cylinder,** of glass, one end closed	$ .20
872.	**Friction Rod,** of sealing wax, large	.20



873

873. **Electrophorus,** an iron plate 10 ins. in diameter, filled with sealing wax, and an 8 in. brass plate fitted with glass handle; very substantial; will last a century 2.50

874. **Plate Electrical Machine,** 14 in. plate, large spherical brass conductor 12.00

New and Improved Tœpler-Holtz Self-Charging Electrical Machine.

After careful investigation and extended experience, we unhesitatingly recommend our New and Improved Tœpler-Holtz Electrical Machine to colleges and schools, believing it to be the best machine for purposes of experimentation now on the market.

We invite special attention to a few of the many commendable features which it possesses: —

1. All parts are adjustable, so as to obtain the best effects at all times.

2. The plates are carefully selected, and are of proper shape.

3. It is provided with a simple, convenient, and effective arrangement for tightening the belt.

4. The location of the driving-wheel and crank is such that the operator does not obstruct the view of the machine.

5. The size of the condensers is relatively large, thereby furnishing a powerful spark.

6. The condensers, which are made to our order of the best quality of glass, are easily removed by means of a suitable device beneath the platform of the machine, thereby enabling the experimenter to change quickly from spark discharges to a continuous flow, whenever the latter is preferable.

7. For shocking purposes, and for experiments with Geissler and other rarefied gas tubes, wires can be inserted beneath brass nuts *EE*, shown in cut on page 140.

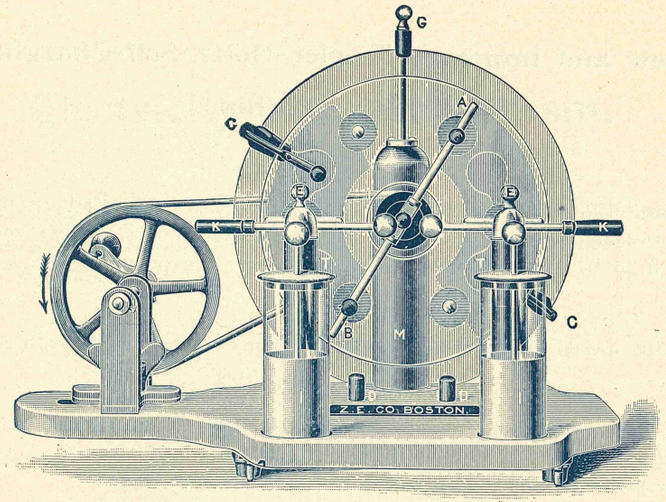
8. The base and pillar are of polished hardwood, and of sufficient size to give a firm support to the stationary plate, and steadiness to the whole machine.

9. The brass-work is lacquered, and the insulation is all of hard rubber, and as perfect as possible.

10. Its construction is such that it may be easily and quickly taken apart for cleaning.

11. Because of its superior mechanical construction it does not readily get out of order.

The letters on the cut (see page 140) refer to instructions for setting up and operating the machine; a set of these instructions accompanies each machine.



875

Diameter of Revolving Plate . . . 12 ins.
„ „ Stationary „ . . . . 14 „

No.		Price.
875.	**Price** of our New and Improved Tœpler-Holtz Self-Charging Electrical Machine, as described on page 139	$23.50
876.	**Tœpler-Holtz Self-Charging Electrical Machine,** as described above, 16 in. revolving plate . . . . . (Larger sizes to order. Prices furnished on application.)	40.00
877.	**"Wimshurst" Improved Self-Charging Electrical Machine,** plates 12 ins. in diameter, constructed in the very best manner and of the finest materials . . . . . The "Wimshurst" machine is rapidly replacing other forms of static machines, is probably less affected by damp atmospheric conditions, generates and discharges quickly, and gives sparks of great length and volume. See cut, page 240.	27.50
877a.	**"Wimshurst" Improved Self-Charging Electrical Machine** (same as No. 877), 14 in. plates	38.50
878.	**"Wimshurst" Improved Self-Charging Electrical Machine** (same as No. 877), 16 in. plates . . . . . (Larger and smaller sizes to order.)	43.50
879.	**Leyden Jar,** one quart, made of Bohemian glass, insulating properties warranted	1.50
880.	**Leyden Jar** (same as No. 879), capacity, three quarts . . .	2.25

No.		Price.
881.	**Leyden Jar,** capacity, two quarts, with movable coatings, for demonstrating that the seat of the charge is on the surface of the glass, and not on the coatings	$3.00
882.	**Leyden Jar Discharger,** with solid glass handle	1.00
883.	**Insulated Stool,** of polished hardwood, very strong glass legs .	4.00
884.	**Cat Skin,** of excellent quality, and nicely tanned . . .	.75
885.	**Cat Skin** (same as No. 884), extra large	1.00
886.	**Pith Balls,** of assorted sizes and colors, per doz. . . .	.25
887.	**Pith Ball Electrometer and Stand**	.35
888.	**Gold Leaf Electroscope,** flask form	.75
889.	**Gold Leaf Electroscope,** larger, with side strips, hardwood base,	2.25
890.	**Induction Cylinder,** with pith balls on stand	4.00
891.	**Ellipsoidal Conductor,** showing unequal distribution . . .	8.00
892.	**Hollow Globe** to show that electric charge resides only on the surface of bodies, with proof plane	4.00
893.	**Proof Plane,** consisting of an insulated handle terminating at one end with a metal disc 1 in. in diameter	.20
894.	**Egg Shells** covered with tin foil for demonstrating that electricity acts across a dielectric, each	.15

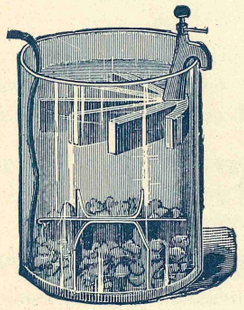
Electrokinetics.

Voltaic batteries, effects produced by the electric current, secondary or storage batteries.

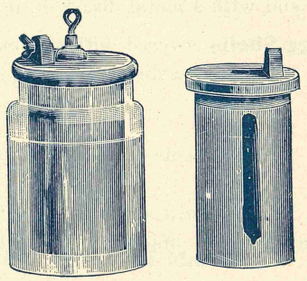
895.	**Strip of copper and two strips of zinc** (one amalgamated, and the other not to be amalgamated), with wires attached, to illustrate simple voltaic cell, per set	$ .40
896.	**Glass Tumblers,** for use with No. 895, each	.05
897.	**Strip of copper and one of zinc,** 1.5 x 10 centimeters, with wire attached, per set	.10
898.	**Copper and zinc strips,** 1.5 x 10 centimeters, fastened together, each	.05
899.	**Daniell Batteries,** well made, with heavy zincs and coppers, one gallon, per cell	1.45

(The Daniell Battery is well adapted to experiments in electrical measurements, the E. M. F. of same being very constant, and varies but slightly with temperature.)

No.		Price.
900.	**Two Fluid Batteries,** one quart (see Ex. XLII., "Hall & Bergen's Physics"), per cell	$ .50
901.	**Porous Cup,** as used in No. 900	.16
902.	**Heavy zinc strip,** 2.5 x 10 centimeters, with wire attached, as used in No. 900	.15
903.	**Copper Strip,** 10 x 10 centimeters, with wire attached, as used in No. 900	.10
904.	**Bunsen Batteries,** one quart, having heavy zinc, binding post for connection, and our improved clamp for carbon, per cell. (In consequence of its high E. M. F., small resistance, reliability and [compared with other batteries of high E. M. F.] durability, this battery is very extensively used, and we highly recommend it for ordinary experimental purposes.)	1.75



905



906

905.	**Crow-foot Gravity Battery,** made in two sizes; 5 x 7 ins., 60 cts.; 6 x 8 ins.	.75
906.	**The Carbon Cylinder Open Circuit Battery** is perfectly uniform and reliable in action. It has an E. M. F. of from 1.5 to 2 volts, and the internal resistance is less than half an ohm. Cell complete	.65

(The same solution as is employed in the Grenet or other plunge batteries may be used in this battery. So used it makes a very cheap and powerful battery for experimental purposes.)

Edison LaLande Battery.

This battery is designed for both open and closed circuit work. Owing to its exceedingly low internal resistance, it is valuable for telegraph work, as well as for operating motors, electroplating purposes, and incandescent lighting.

The solution consists of a 25 per cent. solution of caustic potash in water. To renew a battery, it is only necessary to place a stick of caustic potash in a cell and pour in a requisite amount of water. The internal resistance of these batteries remains constant during their full life.

There is no polarization, and the zincs do not require cleaning. The cells will deliver a large amount of current.

Principal Points.

1. High and constant available E. M. F.

2. No local action, and consequent loss of material, while the chemical action in cell is less than one per cent. per month.

3. Extremely low internal resistance.

4. Cheap materials easily obtained.

5. No attention or inspection required until all the energy of the elements is exhausted.

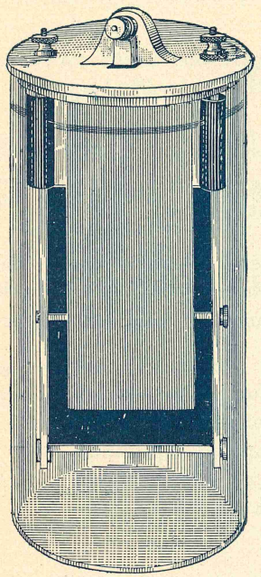
6. Convenience of form and freedom from noxious fumes or chemical deposits.

7. No polarization.

The Edison LaLande is made in seven different types, each one of which is especially designed for the kind of work named, as follows: —

No.				Price.
907.	**Type J.**	**59 Ampere hour.**	Annunciator work, complete	$1.30
908.	**Type Q.**	**150 Ampere hour.**	Small telegraph and motor model, complete	2.00
909.	**Type R.**	**300 Ampere hour.**	Western Union telegraph model, complete	2.70

(Prices of other types on next page.)



910. Type S.
Size over all, 5½ ins. x 13 ins.

No. Price.

910. Type S. 300 Ampere hour. Phonograph model, complete . . . $2.85

911. Type W. 600 Ampere hour. Large motor model, complete . . . 4.85

912. Type X. 40 Ampere hour. Special telephone model, for local transmitters, complete 2.50

Porcelain jars are employed in every type of this battery.

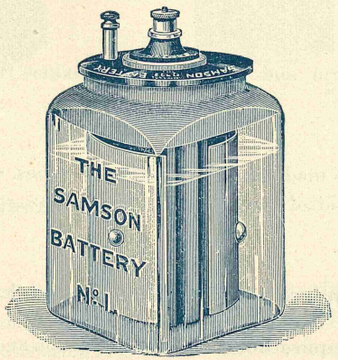
NOTE. — The type S is recommended to schools and colleges in preference to any type in this battery for ordinary experimental purposes.

913. Battery Jar, round, green glass, 4 x 5 ins. . . . . $ .12

914. Battery Jar, „ best white glass, 4½ x 4½ ins. 20

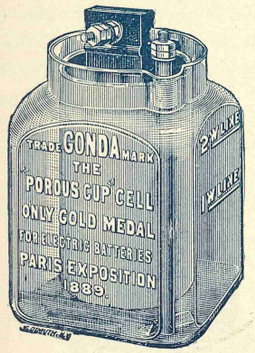
915. Battery Jar, „ „ „ „ 6 x 8 ins. 30

(Battery material of every description constantly in stock.)



916

916. The Samson Battery, No. 1, or Small Cell, has an E. M. F. of 1.44 volts; internal resistance, .14 ohm; current on short circuit is 10 amperes; size of jar, 6 x 3½ x 3½ ins. Cell complete 1.00



918

919

No. Price.

917. The Samson Battery, No. 2, or Large Cell, has an E. M. F. of 1.44 volts; internal resistance, .11 ohm; current on short circuit is 13.4 amperes; size of jar, 6½ x 4 x 4 ins. Cell complete $1.20

918. Gonda Porous Cup Battery, cell complete 75

919. Grenet Battery, 1 pint 1.75

920. Grenet Battery, 1 quart 2.25

921. Grenet Battery, 2 quarts 3.00

The Grenet Battery is especially adapted for experimental and illustrative purposes. It occupies but little space, furnishes an immense quantity of current, is beautiful in design, and, as the zinc can be raised from the fluid, can be kept charged ready for use for many days, and can be set in action any time when required by simply pressing the brass rod which slides through the center of the cover of the cell, and to which the zinc is attached.

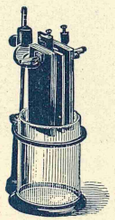
922. Simple Bichromate of Potash Battery, for experimental purposes. Size of glass jar, 2½ x 3½ ins. The elements are zinc and carbon, and are attached to the cover with binding posts for connections 50

The Student's Plunge Battery.

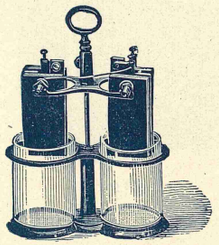
Inside measure of glass jar, 2 x 3 ins.

These batteries are very cheap, powerful, and convenient for experimental purposes. They are mounted on a very neat and compact all-iron stand. The elements are attached to an iron centerpiece, which slides on the center rod, and can all be lowered at once into the fluid. The great strength of this battery, and the easy convenience for setting it in and out of action, make it a *desirable Battery for operating Incandescent Lamps, Electric Motors, Ruhmkorff Coils, Electrolysis Apparatus, etc.*

The batteries are made in eight different sizes.

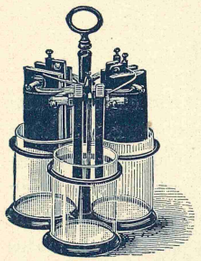


923

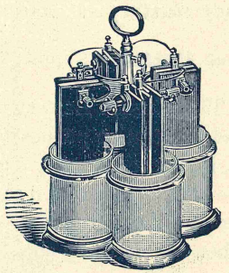


924

No.		Price.
923.	**The One-Cell Student's Plunge Battery** will run an Electro-medical Machine, Electric Bell or Signal	$.85
924.	**The Two-Cell Student's Plunge Battery** will run a Ruhmkorff Coil, Geissler Tube Rotator, or a One-Candle Power Lamp .	1.75



925

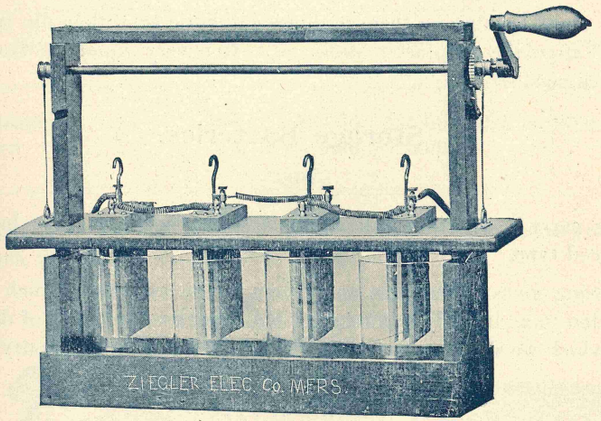


926

925.	**The Three-Cell Student's Plunge Battery** will run a No. 2 Porter Motor, or a Two-Candle Power Lamp	2.50
926.	**The Four-Cell Student's Plunge Battery** will run all the above with increased force, or a Three-Candle Power Lamp . .	3.00

No.		Price.
927.	**The Six-Cell Battery**, consisting of two Three-cell Batteries, will run a Four, or even a Six-Candle Power Lamp . .	$5.00
928.	**The Eight-Cell Battery**, consisting of two Four-cell Batteries, will give ample current for a Six-Candle Power or even larger lamp	6.00
929.	**The Twelve-Cell Battery**, with all elements lowering at once into the solution, with black walnut cover covering it complete	9.00
930.	**The Sixteen-Cell Battery**, with all elements lowering at once into the solution, with black walnut cover covering it complete	12.00

New Pattern Hand-Lift Plunge Battery.



931

Size of Jars, 5 x 7 ins.; Zinc and Carbon Plates, 4 x 6 x 1-4 ins.

931. Our New Pattern Four-Cell Plunge Battery, shown in above illustration, is offered as an extremely efficient and convenient battery for lecture-room and general purposes.

It is so constructed that either one, two, three, or four cells can be lowered at one time, and connections may be quickly made for either intensity or quantity. In neat blackened frame as described 15.00

Solution for and Suggestions as to the Care and Use of Bichromate Battery.

Dissolve one pound of pulverized bichromate of potash, or bichromate soda, in one gallon of warm water; when cool, add one-twelfth its volume of strong sulphuric acid, and stir well. This solution works to best advantage when used fresh, *i. e.*, shortly after mixing.

The zinc of this battery should be lifted out of the liquid as soon as you have finished using it. The layer of solution next to the carbon plate is soon (say after a constant use of half an hour to an hour) deprived of its active oxidizing powers, and then polarization of the negative plate and constant weakening of the current set in.

This difficulty may be partially remedied by occasionally agitating the liquid or allowing it to rest, during which time the various portions of it become homogeneous by diffusion, and the liquid near the carbons becomes more active.

It is best not to allow the solution to remain in the battery longer than two or three days at a time. After removing the liquid, rinse off the elements thoroughly with cold water.

Amalgamating Zincs.

Clean the zincs by dipping them in dilute sulphuric acid, then dip into a vessel of mercury, and allow the surplus to drain off. It is very important that the zincs be kept well amalgamated.

Storage Batteries.

932

We either carry in stock, or can obtain at short notice, storage batteries of the latest improved type.

The following gives dimensions and prices of the two sizes which will serve as some indication to an intending purchaser, but there are a number of different types, as to all of which we shall be pleased to furnish information on inquiry: —

Elements of Type D.

Size of Plates, 6 ins. x 6 ins.

Number of Plates.	3	5	7	9	11	13
Discharge in Amperes — For eight hours	2½	5	7½	10	12½	15
„ five „	3½	7	10½	14	17½	21
„ three „	5	10	15	20	25	30
Normal charge rate	2½	5	7½	10	12½	15
Weight, each element, lbs. . .	8½	14¼	20	27	32½	38¼
Price, each element	$3.00	$5.00	$6.75	$8.50	$10.50	$12.50
Glass jar, extra	1.50	1.65	1.80	1.95	2.10	2.25

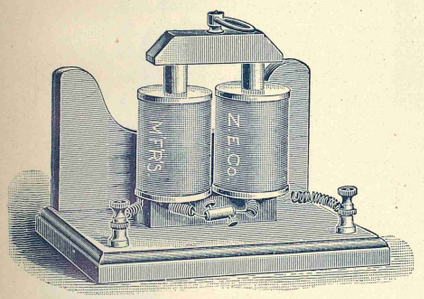
Elements of Type F.

Size of Plates, 10 1-2 ins. x 10 1-2 ins.

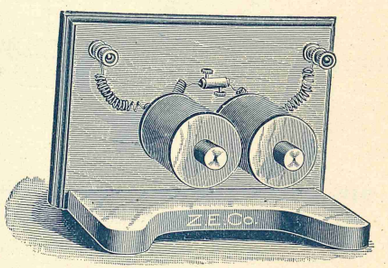
Number of Plates.	9	11	13	15	17	19
Discharge in Amperes — For eight hours	40	50	60	70	80	90
„ five „	56	70	84	98	112	126
„ three „	80	100	120	140	160	180
Normal charge rate	40	50	60	70	80	90
Weight, each element, lbs. . .	85¼	103¾	122	142½	160¾	179½
Price, each element	$30.00	$37.50	$45.00	$52.50	$60.00	$67.50
Glass jar, extra	3.75	5.00	5.00			

Accumulators can also be furnished in a portable form in hard-wood case with handle. Prices, from $5 to $60, according to capacity.

Electromagnets.



934



934

No. — Price.

933. **Electromagnet.** Consists of a round U-shape Magnet Bar, 6 ins. long from curve to ends, two movable helices of insulated copper wire, sustaining from 75 to 100 lbs. weight . . . $4.50

934. **Electromagnet.** Consists of a round U-shape Magnet Bar, 6 ins. long from curve to ends, two movable helices of insulated copper wire, sustaining from 75 to 100 lbs. weight, mounted on heavy base with screw cups 6.00

Every school should have a magnet of like description to recharge Bar Magnets, etc.

No. Price.

935. **Electromagnet,** small . . . . . $ .50

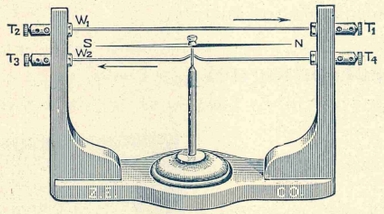
936. **Electromagnet.** Consists of a round U-shape Magnet Bar, 3 ins. long from curve to ends, two helices of insulated copper wire sustaining from 10 to 20 lbs. weight 1.00

937. **Round Norway Iron,** for Electromagnets, 6 x $\frac{1}{4}$ ins. 05

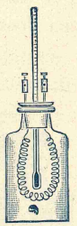
938. **Spools for Electromagnets,** with which pupils can learn to wind magnets, each 30

939. **Apparatus No. 185,** fitted with an electromagnet and an attachment by which the tractive effort of the magnet, when excited by a suitable current, can be measured in the units of the spring balance. This is a very convenient method of arriving at the "pull" of a magnet. Price, complete as described 12.00

All kinds of electromagnets made to order and wound to any desired resistance.



940

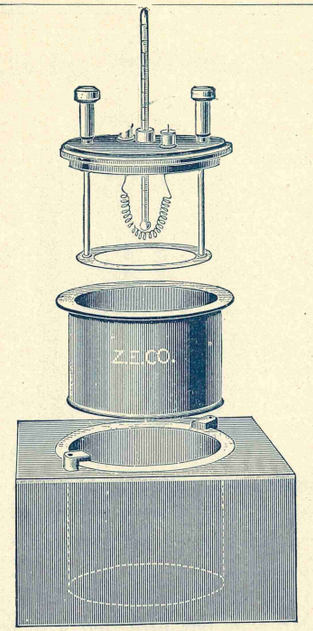

942

940. **Apparatus** for showing deflection of the magnetic needle by a current (see "Principles of Physics," by Gage, Ex. 6, page 479); hard-wood frame, with four binding posts for connections, light magnetic needle mounted with agate bearing on fine needle-point, with neat stand. Complete 3.00

941. **Apparatus** same as last, but without magnetic needle and support 1.80

942. **Calorimeter,** of simple construction, for determining the heating effects of the electric current (see Ex. 449, "Principles of Physics," by Gage), each 5.00

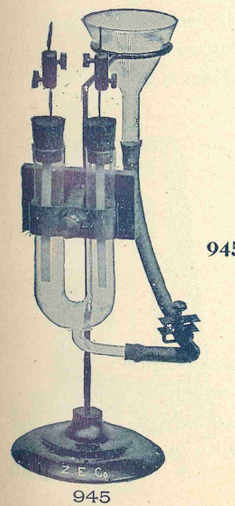
943. **Platinum Wire,** suitable size for heating by current. At market price.



944

No. Price.

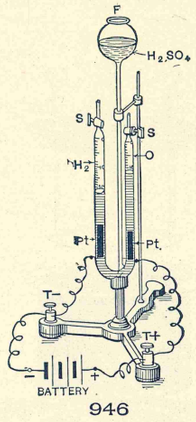
944. **Calorimeter** (see "Stewart & Gee's Physics," Lesson XLVII.). This apparatus consists of a wooden box containing a tin can, the space between the can and the box being filled with lightly packed saw-dust. Within the can a smaller one of thin copper fits, so as to be supported on a felt washer by its lipped edge. A stirring ring, provided with two hammers passing through the cover, is shown in the upper portion of the cut. A spiral of German silver wire, connected to external binding posts, and a thermometer, also pass through the cover $10.00



945

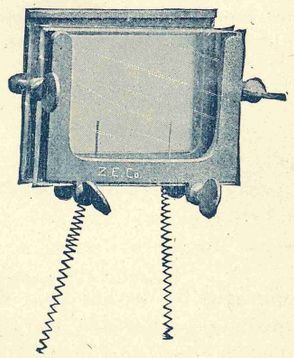
Electrolysis.

945. **Apparatus** for decomposing water, with large platinum electrodes, German pattern (see Gage's "Introduction to Physical Science," page 168, or Gage's "Principles of Physics," page 475) 2.50



946

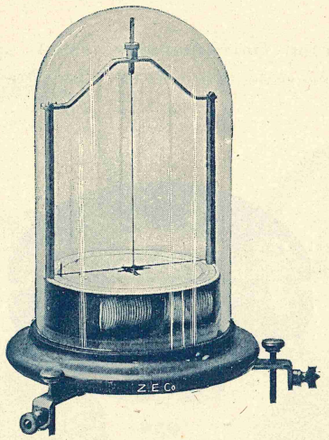
No.		Price.
946.	**Hoffman's Apparatus** for the decomposition of water, showing volumetric composition (see Gage's "Principles of Physics," page 476); two graduated tubes, two stop-cocks, elevated reservoir; all on iron support	$9.50
947.	**Apparatus** similar to No. 946, but provided with plain tubes	7.00
948.	**Apparatus** same as No. 946, but provided with extra glass stop-cock	11.00
	The addition of this stop-cock makes possible the emptying of water and acid without turning the apparatus upside down.	
949.	**V-shaped Glass Tube and Platinum Electrodes** (see Exp. 2, page 476, Gage's "Principles of Physics") for electrolysis	50



624

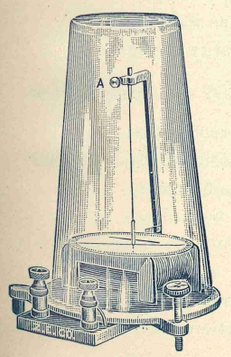
624.	**Tank** suitable for projection, with porte-lumière (see Gage's "Principles of Physics," page 477), the only way in which the "silver" and "tin trees" can be well shown. This tank is very useful for projecting various phenomena connected with chemistry, convection in liquids, etc.	2.50

Instruments for Electrical Measurements.



950

No.		Price.
950.	**Galvanometer,** provided with two needles, which are adjustable as to height, — one astatic used when great sensitiveness is required, the other for ordinary measurements, — both provided with aluminum indicators. It is furnished with levelling screws, and the coils, two in number, are wound with the very best grade of silk insulated wire.	
	There is no instrument now on the market which will answer as well for the different purposes required of a galvanometer in Gage's works on Physics. The results obtained with it will not vary more than one per cent. from those obtained with high-priced tangent galvanometers. The resistance of each instrument is marked on its dial	$6.00



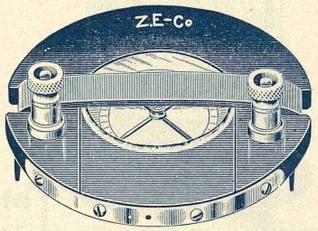
951

951.	**Astatic Galvanometer,** as designed by Dr. Hall, and improved by us; has two coils, scale accurately graduated into single degrees, base, bobbin and frame of metal, astatic pair of needles suspended by unspun silk fiber, levelling screws and stop	3.50
	Suitable for use in connection with Slide Wire Bridge, No. 993.	
	Adjustment of height of needle is effected by means of binding screw *A*, shown in opposite illustration.	

No. Price.

952. **Cardboard Dial,** 2⅝ ins. in diameter, accurately graduated in single degrees, as used in No. 951 . . . . . $ .10

953. **Differential Detector Galvanometer,** small, upright, French form, with silvered scale, two coils of different resistance, under glass shade 4.00



954

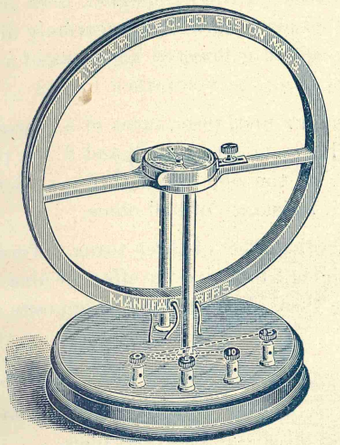
954. **This "Detector Galvanoscope"** is made more on the lines of a legitimate instrument than some of the low-priced material sold under the same name. It will be observed that the coil completely surrounds the magnetic needle, instead of being either above or below it. The base is made of polished hard rubber (the coil covered with silk) and the whole instrument well finished, and the needle is jewel-pivoted. Made in two forms: (*a*) For approximate work, battery tests, etc., with coarse wire and agate bearing 3.50

(*b*) For more delicate work, for small currents where sensitiveness is desired; wound with fine wire, sapphire bearings, and with levelling screws 6.00

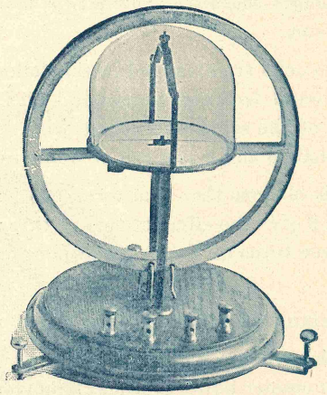
This instrument for Wheatstone bridge work, except for delicate determinations, will frequently answer as well as a high-grade galvanometer, its sensitiveness in the better quality being ample to indicate the pressure of a very small current.

Comparative deflections of the needle, due to the introduction of more or less resistance into the circuit, may also be sufficiently well illustrated, although the results will not be extremely accurate.

The deflection of the needle in different directions according to the direction of the current can also be shown, and various other illustrations will readily suggest themselves to the experienced teacher.



955



956a

No. Price.

955. **Galvanoscope,** consisting of a metal ring 8 ins. in diameter, supported on a hard-wood base. In the center of the ring is placed a delicate silver-dial, agate-bearing compass 45 millimeters in diameter, graduated 0° to 90°. This is wound with fifteen revolutions of No. 20 B. and S. gauge insulated copper wire, and has binding posts for connecting either five, ten, or fifteen convolutions. An excellent galvanometer for elementary school physics $3.00

956. **Same as No. 955,** but provided with paper-dial compass . . 2.50

956a. **Tangent Galvanometer,** constructed on the same general plan as our No. 955, but provided with fiber suspension for needle, cardboard dial graduated in degrees, and levelling screws, as in our No. 950.

The needle is protected by a glass shade. A very sensitive and well-made instrument, capable of good work, at a low price 5.00

New Tangent Galvanometer.

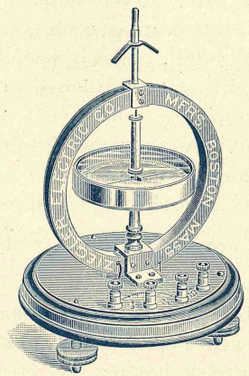
Our New Pattern Tangent Galvanometer, mounted on a highly polished mahogany base with levelling screws, has three sets of coils, controlling magnet, fiber suspension, socket and spindle, 5 in. brass compass box with card dial, accurately divided into single degrees. The needle can be easily raised or lowered by means of a small brass nut.

The coils are arranged in the following manner: first, three turns of a coarse wire are wound between terminals 1 and 2; then between terminals 2 and 3 are twelve turns of the same size coarse wire, but wound in the opposite direction. Between terminals 3 and 4 is a coil of fine wire having a resistance of 320 ohms.

It is obvious then that terminals 1 and 2 give the effect of three turns. Terminals 2 and 3 give the effect of twelve turns. Terminals 1 to 3 give the effect of nine turns, as three turns of the first coil neutralizes three turns being wound in opposite directions.

Terminals 3 and 4 give the effect of 320 ohms of a great many turns of wire.

This arrangement of the coils is the same as in the English post-office tangent galvanometer pattern, which is universally used on single telegraph lines.

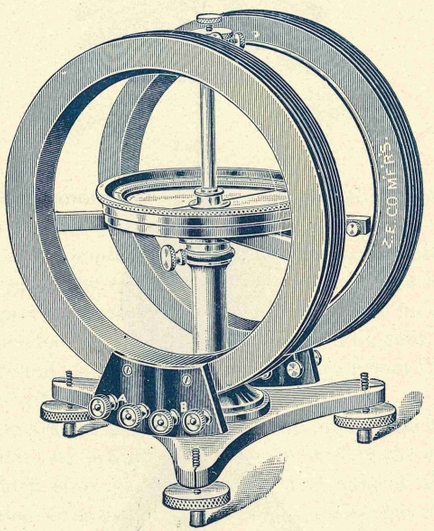


957

No.		Price.
957.	We highly recommend this galvanometer as the best instrument ever produced for the money	$22.00

No.		Price.
958.	**Tangent Galvanometer,** same as last, but provided with swivel and mounted on brass tripod with levelling screws	$30.00
959.	**Tangent Galvanometer,** mounted on hard-wood base with levelling screws, has coil 7½ ins. in diameter, fiber suspension, socket and spindle, 7 in. compass-box with card dial accurately divided into single degrees. Resistance of coil about ⅛ ohm. An excellent instrument at a low price	10.00

Helmholtz-Gaugain Galvanometer.

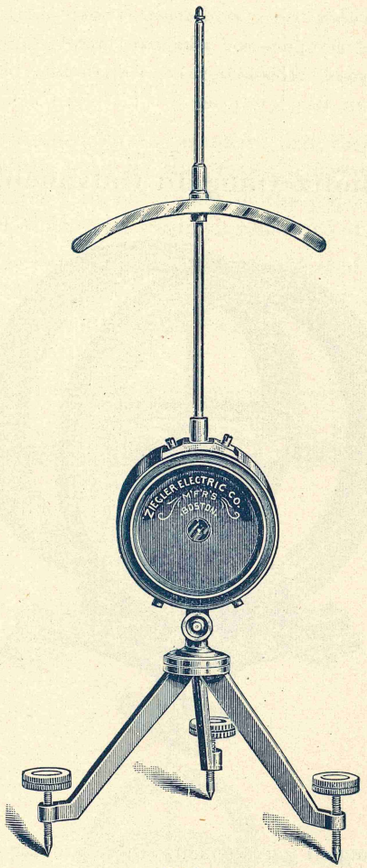


960

960. In this form of tangent galvanometer there are two similar coils placed with their planes vertical and parallel, and so that the distance of each coil from the center of the magnet is equal to half the radius of either coil. The needle is suspended by fiber at the middle point of the axis of the two coils. The result of this arrangement is an extremely uniform magnetic field, the needle of course being very short in comparison with the radius of the coils.

The instrument is provided with a 6 in. silver plate compass-box graduated to half degrees. One set of coils is of practically no resistance, being wound with only a few convolutions of thick wire; the other set can be wound to any resistance up to 500 ohms 85.00

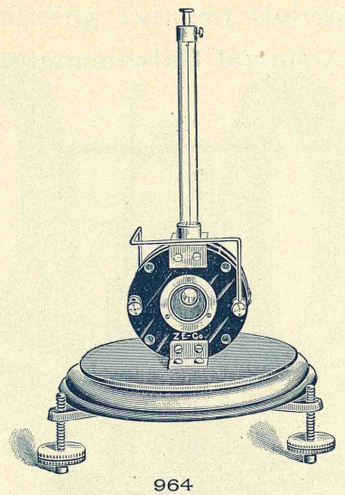
Thomson Mirror Galvanometer.



961

Thomson Mirror Galvanometer, complete with two coils (connected in series unless otherwise ordered).

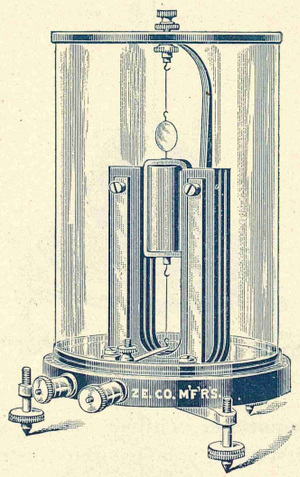
No.		Price.
961.	**Resistance** 2 ohms to 150 ohms	$50.00
962.	**Resistance** 170 ohms to 3,000 ohms	70.00
963.	**Square pattern,** 170 ohms to 3,000 ohms	90.00



964

No		Price.
964.	**The Reflecting Galvanometer,** with air damper, shown in above illustration, is a first-class and accurate instrument. It is very sensitive, and resembles the Thomson Mirror Galvanometer in general design. The mirror carries the magnet, consisting of several small pieces of steel, on its back, the whole being very light, and suspended by a fine cocoon fiber. The coils, two in number, are wound on hard rubber spools, are removable, and may be connected in series or multiple, as required. The magnetic system is enclosed by a thin plane glass in front, and by a similar one behind; the latter is fixed in the end of a small tube which slips easily in the central axis of the rear coil, so that the air-space may thereby be easily increased or decreased at will. The galvanometer may, in this way, be made "dead beat," or used undamped as desired; by pushing in the sliding tube until the air-space becomes small, readings may be taken with great rapidity, as the mirror will come to rest quickly. The galvanometer may be made even more sensitive by the use of a controlling magnet. We can confidentially recommend this instrument. Total resistance, 100 ohms	$20.00
965.	**Same as No. 964,** but with brass tripod and swivel . . .	25.00
966.	**Same as No. 964,** „ „ total resistance 800 ohms . .	22.00
967.	**Same as No. 964,** „ „ „ „ 2,000 „ . .	25.00
968.	**Lamp, Stand, and Scale,** suitable for use with either of the above-mentioned instruments	7.50

D'Arsonval Galvanometer.



969

No. Price.

969. This form of Galvanometer consists of a coil of wire suspended between the poles of a permanent horseshoe magnet, having the lines of force concentrated by an interior iron core, and retained in normal position by two wires top and bottom, which also convey current to the coil. One feature of this instrument is its "dead-beat"-ness, as it comes to rest very quickly.

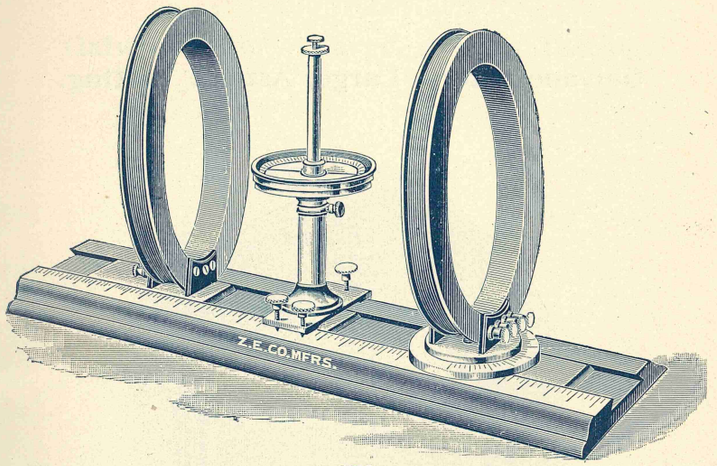
It is a very popular instrument in the hands of electricians for all purposes requiring sensitiveness, rapidity, and ease of manipulation. When deflected by a current, the index or mirror takes its position immediately, without the slightest oscillation. The instrument is also very valuable in that it can be used very near dynamo machines without being affected, this being almost the only way of making measurements of great accuracy on dynamos when they are running. It is used with a lamp and scale similar to that for the Thomson Reflecting Galvanometer $35.00

970. Deprez D'Arsonval Reflecting Galvanometer, on hard rubber base 50.00

971. Deprez D'Arsonval Reflecting Galvanometer, differential . 60.00

972. Shunt of $\frac{1}{9}$ and $\frac{1}{99}$ for above 20.00

Double Sliding Tangent Galvanometer.

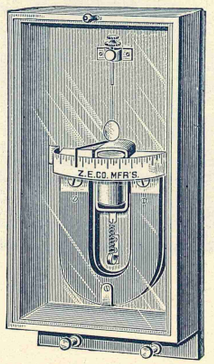


973

No. Price.

973. This is a convenient form of instrument for many purposes, and resembles in some respects the Wiedemann instrument. The two coils, which are movable along the graduated scale, can be connected in series or multiple, or differentially. They can be used together or separately. The sensibility of the instrument can thus be varied without the use of shunts (see "Stewart & Gee's Physics," page 204). $38.00

974. Same as No. 973, with mirror for use with scale 46.00

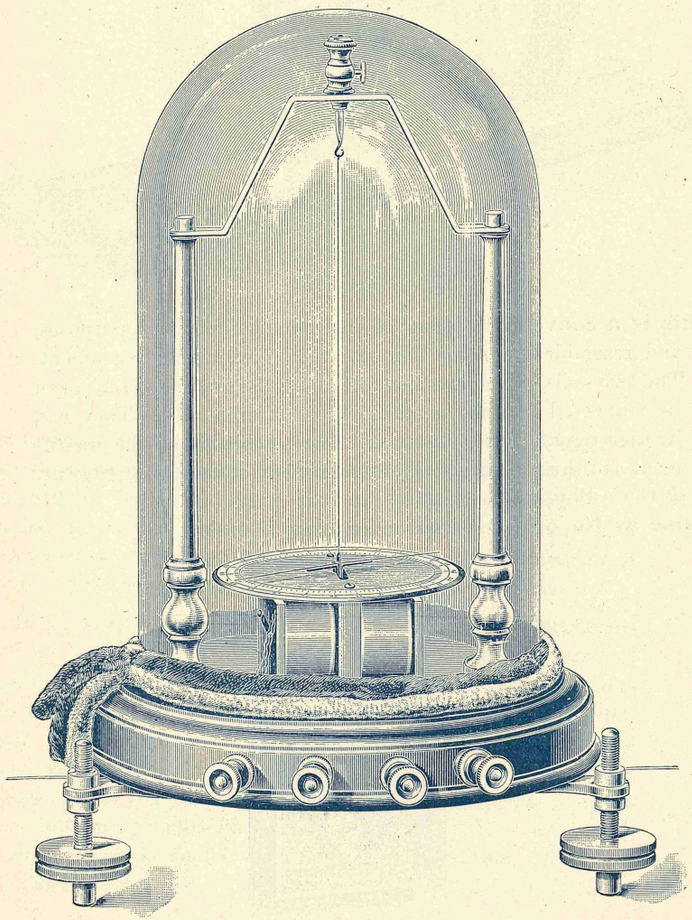


975

975. Wall form of Deprez D'Arsonval Galvanometer 16.00

The readings can be taken by means of the mirror, or from the graduated scale. This is intended to be fastened to any convenient wall or other suitable support, and, for the price, is a very reliable and accurate instrument.

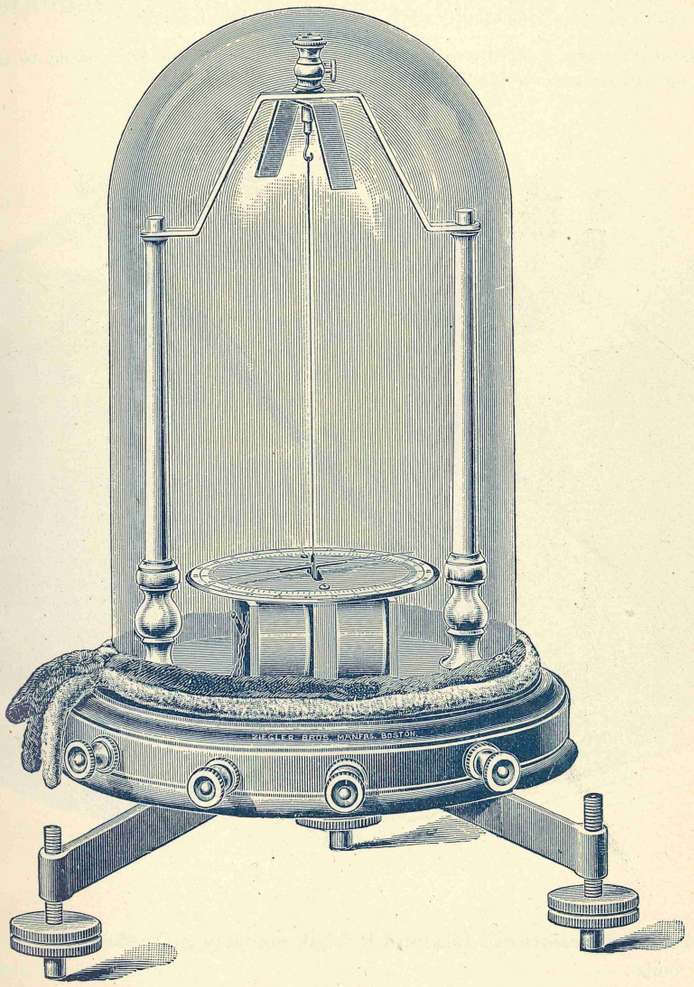
Galvanometer — Large, Astatic Testing.



976

No.		Price.
976.	**Fiber-suspension,** silvered dial, made and finished in the most thorough and workmanlike manner, with either one, two, or three coils, as preferred	$35.00

Galvanometer — Large, Astatic Testing.



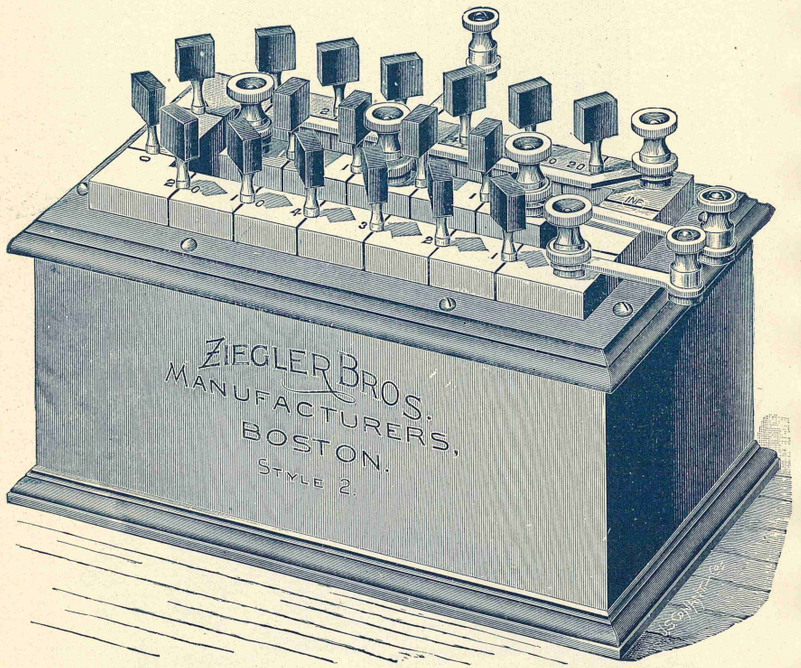
977

No.		Price.
977.	**Similar to No. 976,** but provided with swivel and controlling magnet	$46.00

Rheostats and Bridges.

NOTE. — **Our style No. 1 Rheostat** is made only to order for special work, cable testing, or for other determinations on high resistances or unusual work. This necessarily involves the greatest care and the highest grade of skilled workmanship. The prices are, however, as low as is found possible consistently with meeting these requirements.

We must decline any competitive bidding, but we shall always be pleased to make estimates or quotations to *bona fide* intending purchasers.



978

No. | Price.

978. **Standard Resistance Box and Bridge,** containing the following coils: —

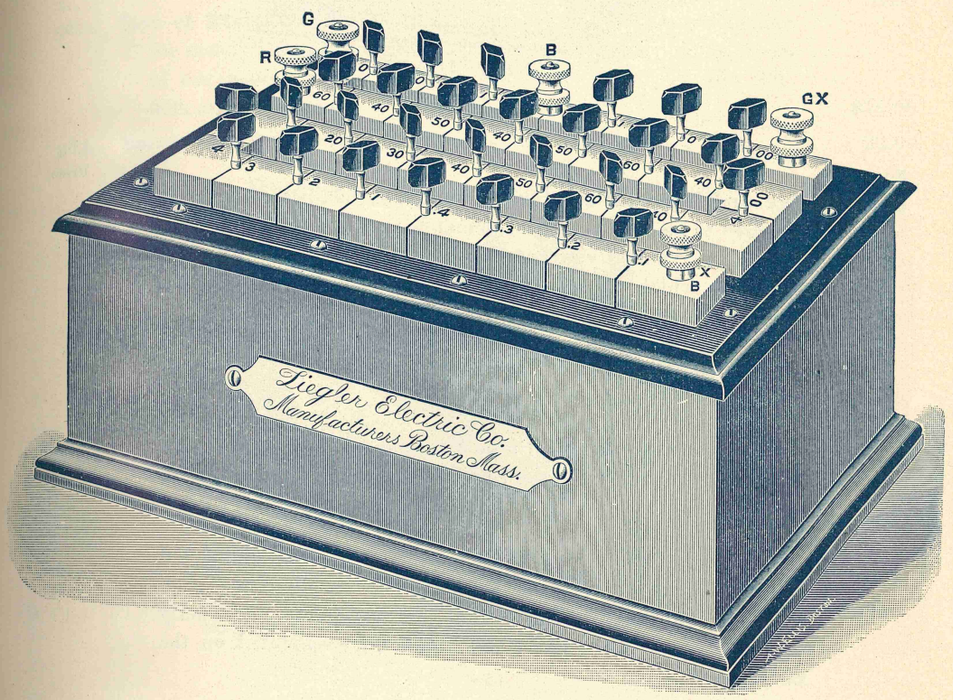
Rheostat 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, and 400 ohms.

Bridge Coils 100, 10, 10, 100 ohms.
A first-class instrument in every respect $80.00

No. | Price.

979. **Standard Resistance Box and Bridge,** similar to No. 978, but without top copper connections $76.50

Standard Testing Resistance Box and Bridge.

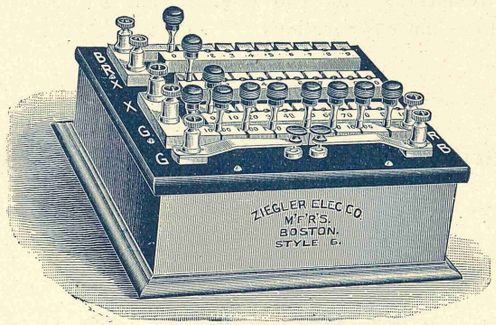


980

980. **Standard Testing Resistance Box and Bridge,** containing the following coils: —

Rheostat 10,000, 4,000, 3,000, 2,000, 1,000, 400, 300, 200, 100, 40, 30, 20, 10, 4, 3, 2, 1, 0.4, 0.3, 0.2, 0.

Bridge Coils 1,000, 100, 10, 10, 100, 1,000 . . . . . 125.00



981

No. Price.

981. Bridge and Rheostat combined. This box has been especially designed to meet the constant demands made on us for a reliable and conveniently arranged Wheatstone Bridge and Resistance Set, which would have a wide range and yet be inexpensive.

The first row of the rheostat contains nine $\frac{1}{10}$ ohm coils, making 0.9 ohms.

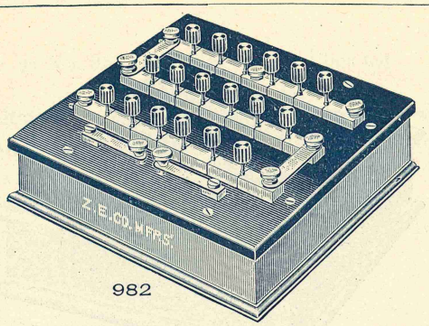
The second row of the rheostat contains ten 1 ohm coils, 10 ohms. The third row of the rheostat contains ten 10 ohm coils, 100 ohms.

The bridge-arm coils are 1,000, 100, 10, 10, 100, and 1,000 ohms. The total range of measurement is, therefore, from $\frac{1}{1000}$ of an ohm to 11,090 ohms. Separate keys, properly connected, for battery and galvanometer, are mounted on the same top with the set.

No special skill is needed in making proper connections with this set, as all terminals are marked.

The object whose resistance is sought is connected at *XX*, and the galvanometer at *GG*. The battery is connected at *B*. No connection is made at *R*, as that terminal is only used when the rheostat is to be used without the bridge or galvanometer.

The rheostat and bridge are mounted together on a neat, polished hard-wood box with solid hard rubber top, and the plugs are ground to perfect contact. A reliable and accurate instrument at a low price $28.00



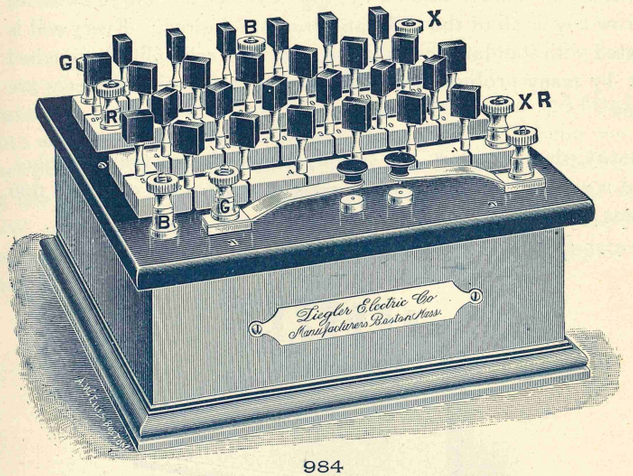
982

No. Price.

982. Box of Resistance Coils, of construction and accuracy sufficient for most purposes, though not of the same high grade as others of our manufacture. Coils 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, and 400 ohms $18.00

983. Same with Bridge Coils 100, 10, 10, and 100 ohms . . . 22.00

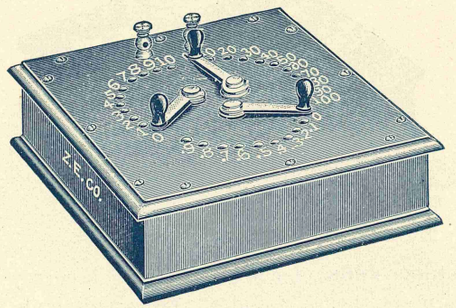
Bridge and Rheostat Combined.



984

984. The illustration above shows a larger size of a low-priced form of bridge and rheostat than our No. 981, with battery and galvanometer keys on the same base. The connections are marked, but a diagram in further explanation will be furnished with each instrument. The arrangement of the coils differs from No. 981, and resembles somewhat more the "P. O." type, like our standard instruments.

The bridge coils are 1,000, 100, 10, 10, 100, 1,000 ohms, and the rheostat coils are .1, .2, .3, .4, 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1,000, 2,000, 3,000, and 4,000. This instrument is thoroughly well made and reliable, though of course not of the same construction as our standard high-grade instruments . 40.00

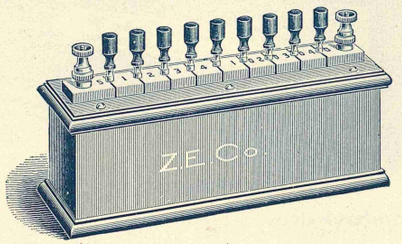


985

No. Price.

985. **Rheostat or Resistance Box,** containing a series of coils of German silver wire, whose resistance ranges from 0.1 ohm to 100 ohms; total resistance, 110.9 ohms. Each of these coils is connected with a brass stud on the top of the box. Three switches throw any or all of the coils into circuit as desired. Every coil is tested with standard instruments, and their reliability is vouched for by many professors in colleges where these instruments are used $4.50

986. **Rheostat,** similar to last, but larger, provided with four switches, and a series of coils ranging in resistance from 0.1 ohm to 1,000 ohms; total resistance, 1,110.9 ohms 7.00



987

987. **Rheostat** in neat polished hard-wood box, plug connections, having nine coils, viz.: 0.5, 1, 2, 3, 4, 10, 20, 30, and 40 ohms; 110.5 ohms in the aggregate 9.00

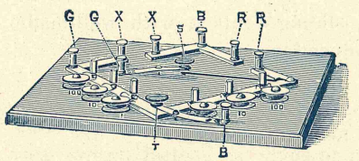
988. **Same, with hard rubber top** 10.00

989. **Rheostat,** in neat polished hard-wood box, plug connections; three sets of resistances, viz.: 0.1, 0.2, 0.3, 0.4, 1, 2, 3, 4, and 10, 20, 30, 40 ohm coils, making 110.9 ohms 13.00

No. Price.

990. **Rheostat,** same as No. 989, but with hard rubber top . . $15.00

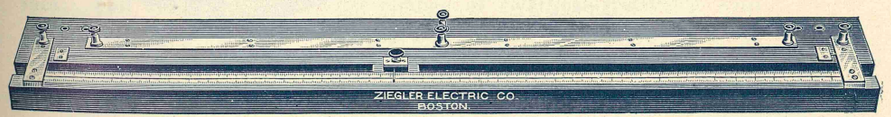
We unhesitatingly recommend these instruments as the best low-priced boxes made. By the use of well-made plugs, a far greater degree of accuracy is attainable, and better contact made than by use of switch connections. They are all compared with standards, and may be relied upon as fairly accurate and fully adequate for the work required of them.



991

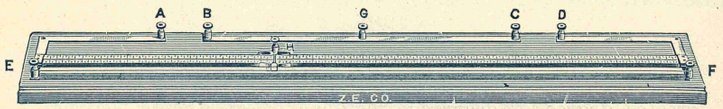
991. **Wheatstone Bridge,** mounted on neat hard-wood base and fitted with well-made plugs and keys, and having heavy platinum contact points. The battery wires are connected with the bridge at the binding post *BB*. The galvanometer is connected at *GG*, a resistance box at *RR*, and the conductor whose resistance is sought at *XX*. A very convenient and popular bridge at a low price 3.75

Wheatstone Slide-Wire Bridge.



992

992. **Extra Heavy Connections and Binding Posts;** platinoid wire, with accurately divided millimeter scale and improved slider, all mounted on heavy hard-wood base 8.00



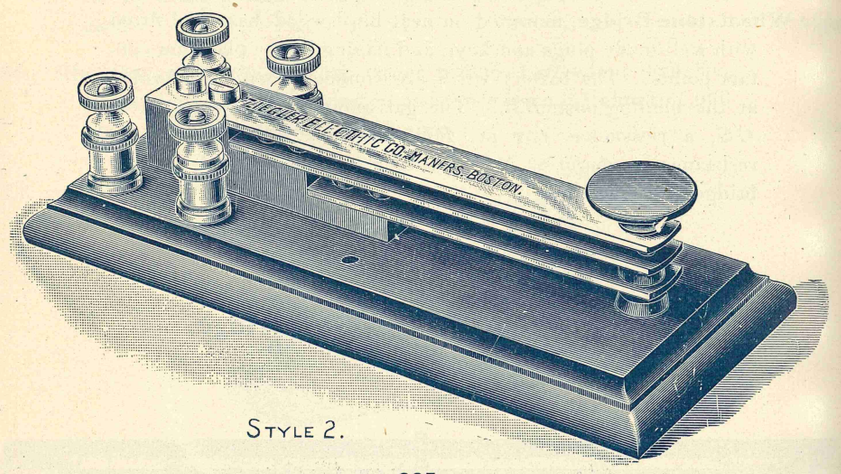
993

No. Price.

993. **Elementary Wheatstone Slide-Wire Bridge,** a modified and cheaper form of No. 992, designed by Dr. Hall, and improved by us. It is made with extra heavy connections, accurately divided millimeter scale, hard-wood base, German silver resistance wire, and sliding contact, with well-made English binding posts for connections $4.25

994. **Contact Key,** mounted on wooden base with screw-cups, useful for making and breaking circuit 75

Double Contact Key.



STYLE 2.

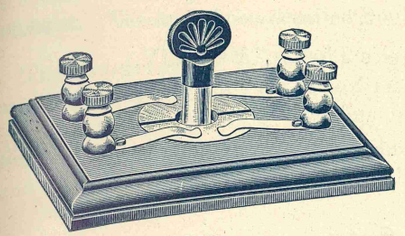
995

995. **Neatly finished,** hard rubber base 12.00

996. **Neatly finished,** mahogany „ 10.00

997. **Similar Key** for closed circuits, rubber base 13.00

998. **Similar Key** „ „ „ mahogany base 11.00



999

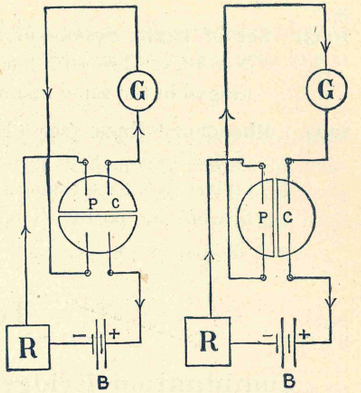


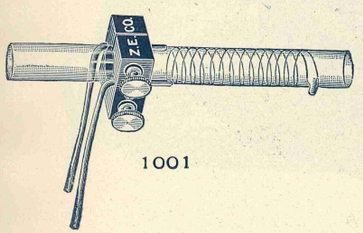
Diagram showing connections with No. 999.

No. Price.

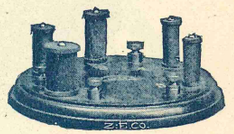
999. **Pole Changer or Current Reverser,** mounted on wooden base, improved form, with switch instead of plugs or mercury cups; very useful in eliminating error of parallelism between needle and coil of galvanometer (see Gage's "Physical Laboratory Manual," Exps. 124–7) $1.25

In the above diagram showing method of connecting with Pole Changer, T represents Galvanometer, R, Rheostat, B, Battery, and P C, Pole Changer.

1000. **Pole Changer,** with plugs 1.00



1001



1002

1001. **Coil of Wire** for testing change of electrical resistance with change of temperature, according to Hall & Bergen, wound in the grooves of a hard rubber tube, nicely constructed . . 1.00

1002. **Set of Five Spools of Double Silk Insulated Wire,** according to Gage, mounted on hard-wood platform, containing wires of different (known) lengths, sizes, and material, whose resistances are to be measured and compared. The arrangement is such that any one, two, or more spools of wire can be introduced into the circuit for the purpose of measurement of resistance.

An instrument of great convenience in a school laboratory . 2.40

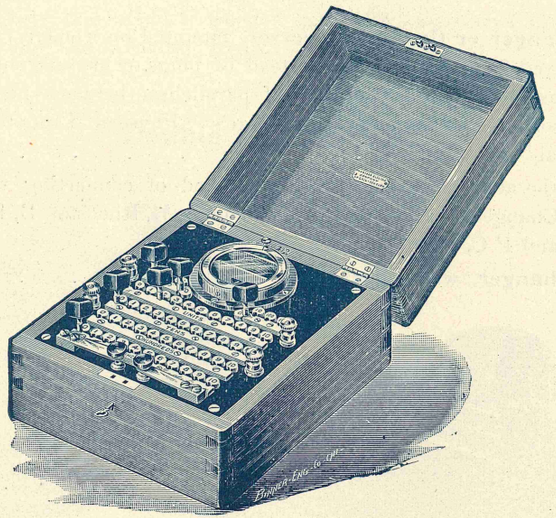
No. Price.

1003. **Set of Eight Spools of Double Silk Insulated Copper Wire** No. 30, of different lengths, according to Hall & Bergen, arranged in the same manner as No. 1002, on hard-wood platform $2.60

1004. **Rheochord Rack** (see "Hall & Bergen's Physics," Ex. XLIV.), of hard wood, with twenty-five meters No. 30 copper wire, ten meters No. 38 German silver No. 30, and ten well-made English binding posts. The wires are not in position. Each . 2.25

Testing Sets.

Combination Bridge, Rheostat, and Galvanometer.



1005—Style A.

This instrument consists of a sensitive Detector Galvanometer and an improved form of Wheatstone Bridge, with Rheostat, all arranged in one case so as to form a complete and perfect portable apparatus for measuring resistances. We manufacture two sizes:—

Style A measures from $\frac{1}{100}$ of an ohm to 111,000 ohms. It has on each bridge-arm coils of 10 ohms, 100 ohms, and 1,000 ohms. The rheostat consists of three rows of ten coils each, the first row contains coils of 1 ohm each, designated "units," the second of 10 ohms each, designated "tens," and the third of 100 ohms each, designated "hundreds." The case is of polished mahogany, measuring $8\frac{3}{4}$ x $8\frac{3}{4}$ x $5\frac{1}{2}$ ins.

Style B measures from $\frac{1}{100}$ of an ohm to 1,111,000 ohms. The construction is the same as in No. 1, but there is an additional row of ten 1,000 ohm coils in the rheostat. The size of the same is $8\frac{3}{4}$ x 10 x $5\frac{1}{2}$ ins.

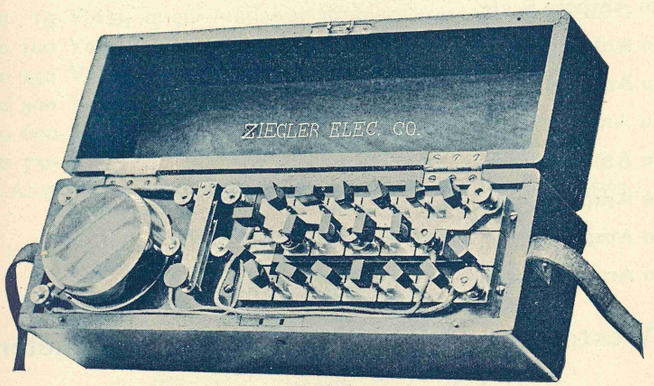
The arrangement of the coils is such that one plug only is used to each row, thus avoiding the multiplicity of bad connections on account of ill-fitting plugs, and making the reading as simple as possible. If, for instance, in balancing the bridge, it is required to put the plug of the "hundreds" row into "7," of "tens" row into "5," and of "units" row into "3," instead of adding up the coils, one reads 753 ohms.

No. Price.

1005. **Style A** $75.00

1006. **Style B** 85.00

Portable Testing Set.

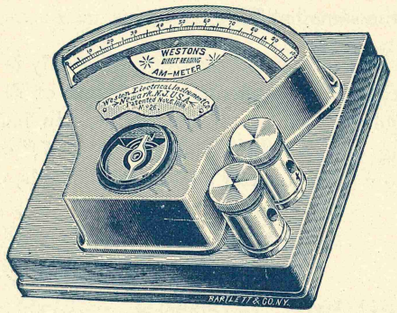


1007

1007. **This set** is thoroughly well made, and is mounted in a polished hard-wood box, with strap for carrying. It is provided with a delicate galvanometer and double contact key. The coils are 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1,000, 2,000 ohms, and bridge coils 100, 10, 10, 100 ohms. Jewelled bearing for galvanometer 80.00

1008. **Same as No. 1007,** with galvanometer arranged to be raised, and provided with silk fiber suspension. More sensitive than jewelled bearing 90.00

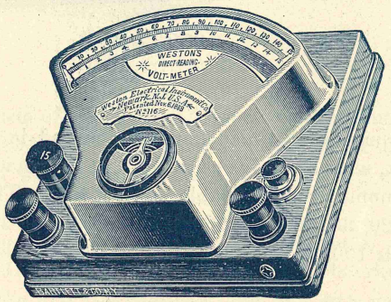
Weston Standard Direct-Reading Ammeter.



1019

No.		Price.
1009.	**5 Ampere Scale,** each	$65.00
1010.	**15 Ampere Scale,** „	65.00
1011.	**25 Ampere Scale,** „	65.00
1012.	**50 Ampere Scale,** „	65.00
1013.	**100 Ampere Scale,** „	70.00
1014.	**150 Ampere Scale,** „	75.00
1015.	**200 Ampere Scale,** „	80.00
1016.	**250 Ampere Scale,** „	80.00
1017.	**300 Ampere Scale,** „	80.00
1018.	**400 Ampere Scale,** „	90.00
1019.	**500 Ampere Scale,** „	90.00

Weston Standard Direct-Reading Voltmeter.



1020

1020.	**0 to 150 Volts,** by single volts	55.00
1021.	**0 to 150 Volts,** with contact key and calibrating coil	60.00

No.		Price.
1022.	**0 to 150** } double scale	$75.00
1023.	**0 to 15** }	
1024.	**0 to 300,** by two-volt divisions	65.00
1025.	**0 to 600,** „ five-volt „	65.00

The above are standard reliable instruments, and such as would most usually be required for scholastic purposes. We can supply, however, a variety of instruments, both of the Weston and other makes, and for station purposes, as well as portable testing instruments for alternating currents, Watt-meters, etc., etc.

If a prospective customer will write us, stating his requirements as nearly as possible, we shall be pleased to furnish any information.

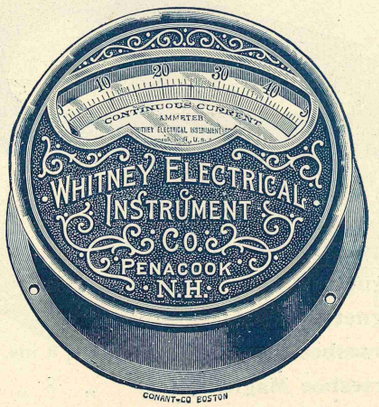
As an example of another form we append a cut of the Whitney instruments, which are very fairly accurate and reliable, at a lower price than the Weston.

Whitney Voltmeters.

1026.	**0 to 15 Volts,** in one-tenth-volt divisions	24.00
1027.	**0 to 100 Volts,** „ one-volt „	26.00
1028.	**0 to 150 Volts,** „ „ „	27.00
1029.	**0 to 300 Volts,** „ three-volt „	30.00
1030.	**0 to 600 Volts,** „ five-volt „	34.00
1031.	**0 to 750 Volts,** „ „ „	36.00

(Any desired range, high or low, made to order on short notice.)

Whitney Ammeters.



1034

1032.	**0 to 10 Amperes,** in one-tenth-ampere divisions	23.00
1033.	**0 to 25 Amperes,** „ one-fifth-ampere „	23.00
1034.	**0 to 50 Amperes,** „ one-half-ampere „	24.00

No.		Price.
1035.	**0 to 100 Amperes,** in one-ampere divisions	$25.00
1036.	**0 to 150 Amperes,** „ „ „	26.00
1037.	**0 to 280 Amperes,** „ two-ampere „	28.00
1038.	**0 to 600 Amperes,** „ five-ampere „	30.00

(Any desired range, high or low, made to order on short notice.)

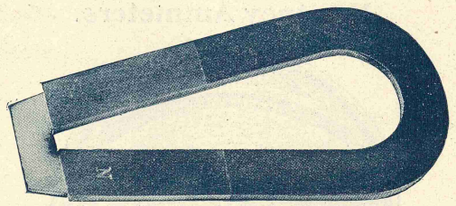
Magnets.

1039-1046

1039.	**Bar Magnet,** ¼ x ¾ x 6 ins.	.40
1040.	**Bar Magnet,** ¼ x ⅞ x 10 „	.65
1041.	**Bar Magnet,** ¼ x ⅞ x 12 „	.75
1042.	**Bar Magnet,** ¼ x 1 x 12 „	.80
1043.	**Pair of Bar Magnets,** each ¼ x ¾ x 6 ins., with keepers .	.75
1044.	**Pair of Bar Magnets,** „ ¼ x ⅞ x 10 „ „ „ .	1.35
1045.	**Pair of Bar Magnets,** „ ¼ x ⅞ x 12 „ „ „ .	1.55
1046.	**Pair of Bar Magnets,** „ ¼ x 1 x 12 „ „ „ .	1.65

(Keepers for any of the single Bar Magnets mentioned above will be supplied at an extra charge of ten cents.)

1047.	**Breaking Magnets** for Exp. 69, "Hall & Bergen's Physics," each	.15

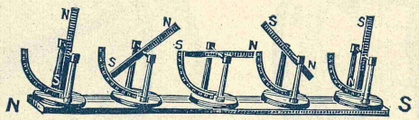


1048-1050

1048.	**Horseshoe Magnets,** 4 ins. long, with keeper . . .	.25
1049.	**Horseshoe Magnets,** No. 150, 8 ins. long, with keeper . .	1.00
1050.	**Horseshoe Magnets,** 9 ins. long, with keeper . . .	1.25
1051.	**Compound Horseshoe Magnets,** three bars, 8 ins. long .	2.25
1052.	**Compound Horseshoe Magnets,** four „ 8 „ „ .	2.60
1053.	**Circular Magnetized Steel Disc,** for illustration of lines of magnetic force (see Exp. 156, Gage's "Introduction to Physical Science," and page 523, Gage's "Principles of Physics") .	.50
1054.	**Iron Filings,** selected, very fine, for use with No. 1053, per lb.	.10

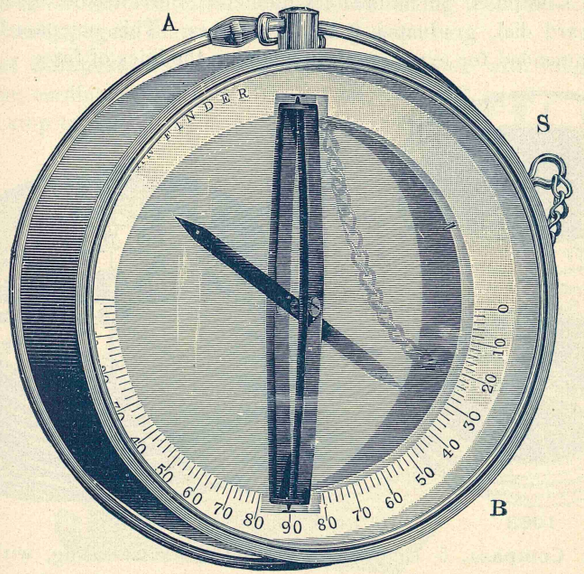
Magnetic and Dipping Needles.

No.		Price.
1055.	**Magnetic Needle,** 3 ins. long, on stand	$ .60
1056.	**Magnetic Needle,** 6 „ „ very light, mounted with agate bearing on fine needle point, with neat stand	1.20



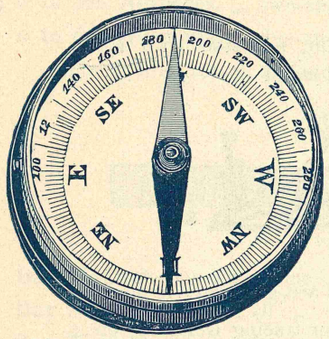
1057

1057.	**Dipping Needle,** with fine mounting, and arc, graduated in degrees	1.75
1058.	**Compass,** miner's, or dipping needle for tracing iron ore, etc.; has 2½ in. magnetic needle delicately balanced, on adjustable agate centers, and traversing graduated 3 in. silvered dial of 180 degrees, with improved stop to needle and ring, highly sensitive; the inclination of the needle as read off on the graduated circle will show the dip. Each	10.00

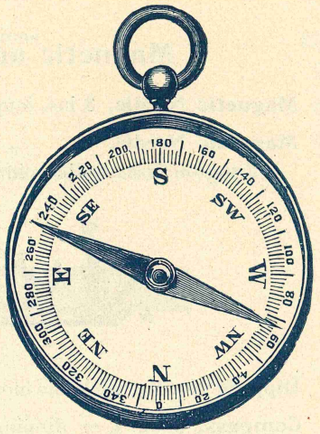


1059

1059.	**Compass,** miner's, improved by having the needle swung between parallel aluminum pivoted bars, allowing motion in azimuth as well as altitude, insuring correct finding of the true magnetic meridian, 3½ ins. in diameter, in morocco case	13.50

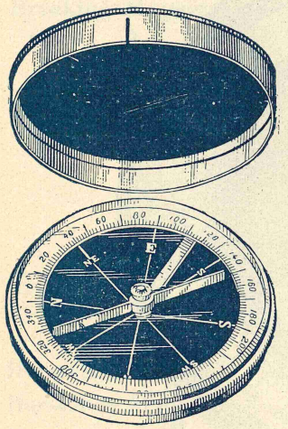


1060

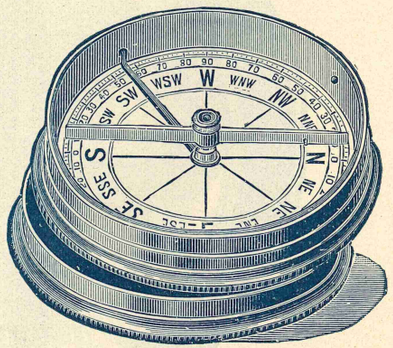


1061

No.		Price.
1060.	**Pocket Compass,** with pull-over cover, 4 centimeters face, card dial, graduated into single degrees, each	$ .30
1061.	**Pocket Compass,** 4 centimeters diameter, open-face card dial, graduated into single degrees, each	.30
1062.	**Pocket Compass,** 25 millimeters diameter, short needle, open-face card dial, graduated 0 to 90 degrees. This compass is recommended for experiments in mapping the lines of force .	.25

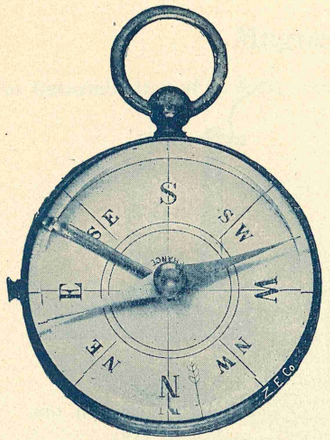


1063

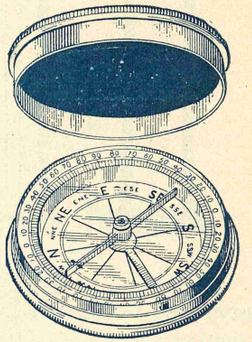


1064

1063.	**Pocket Compass,** 5 centimeters diameter, metal casing, with pull-off reversible cover, makes automatic stop to edge of bar-needle, silvered metal dial with raised ring, divided 0 to 360 degrees, agate center, each	3.25
1064.	**Pocket Compass,** 2 in. diameter, with pull-off milled edge cover, silvered metal dial, bar-needle with self-acting stop, brass, agate center, each	2.75

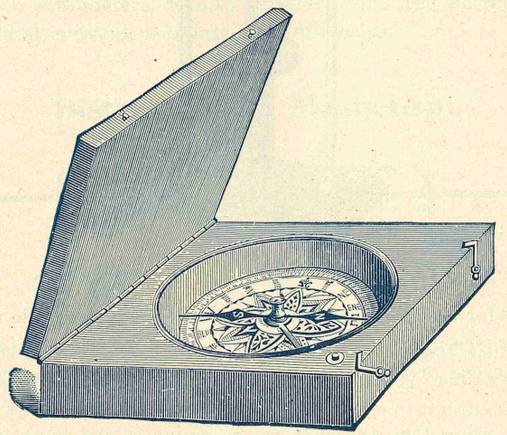


1065



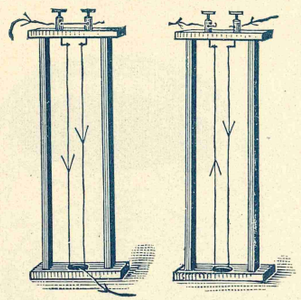
1066

No.		Price.
1065.	**Pocket Compass,** open face, 4½ centimeters diameter, lacquered brass casing, silvered dial with cardinal points, brass center and stop to needle, each	$ .65
1066.	**Pocket Compass,** 5 centimeters diameter, with pull-off milled edge cover, silvered metal dial and raised ring with divisions, bar-needle, agate center and self-acting stop	3.00
1067.	**Pocket Compass,** 2¾ in., polished mahogany box with hinged cover, cardinal points and divisions on card dial, agate center and stop to needle, divided 0 to 360 degrees, each . . .	1.00

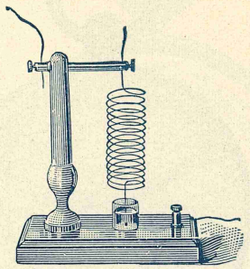


1068

1068.	**Pocket Compass,** similar to preceding, with silvered dial, agate center and stop to bar-needle and raised ring, each . . .	3.00
1069.	**Floating Cell** and connected solenoid, which behaves like a magnetic needle (see pages 538, 539, "Principles of Physics") .	1.50



1070



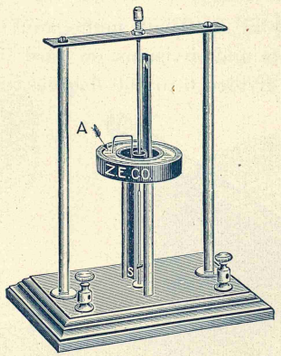
1071

No. Price.

1070. Apparatus to illustrate the action of parallel currents on one another (see Gage's "Principles of Physics," page 542) . . $ .75

1071. Apparatus (same as No. 1070), with contracting helix . . 1.10

Both Nos. 1070 and 1071 will give best results if the ends of such wires as dip into the mercury be amalgamated before using. Do not allow the ends of the wires to dip very deep into the mercury.



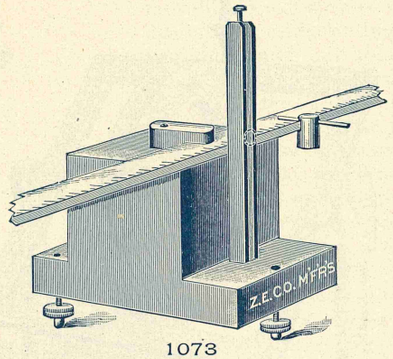
1072

1072. Apparatus for demonstrating the rotation of a magnetic pole round a current (see "Principles of Physics," by Gage, page 544), requires but one or two cells of the Plunge Battery, nicely constructed 3.50

When using last, see that the mercury in the circular cup shall come just high enough to touch the extreme end of bent wire *A* (see above illustration). If a solution of sulphuric acid and water (say about equal parts by volume of each) be poured on top of the mercury, the apparatus will work very satisfactorily.

Magnetometer.

For Determination of H. & M. ("Stewart & Gee," Vol. II., Lesson X.).

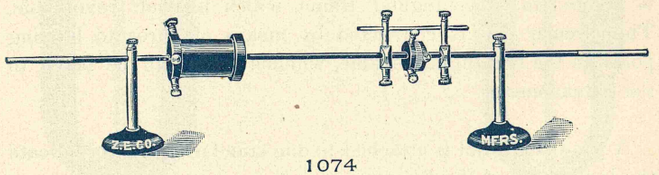


1073

No. Price.

1073. Magnetometer. On a base, supported by levelling screws (see cut), is fixed an upright having formed in its front face a fine groove, which at a point near the middle of the upright expands into a small shallow chamber. In this little chamber is suspended, by a silk fiber, a small magnetized piece of steel with a light mirror attached; the chamber being closed in by glass, and constructed of metal only slightly larger than the magnetic mirror system, the apparatus is nearly dead beat. A scale, divided in millimeters, is also provided, and the magnet can be placed at convenient points along its length . . . $20.00

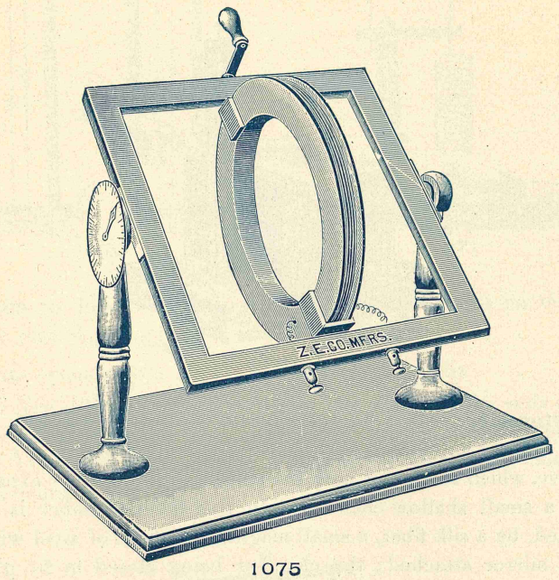
Distribution of Magnetism.



1074

1074. The Apparatus here shown consists of a bar of soft iron (with brass ends) supported on standards. The large bobbin or coil of wire may be clamped at any point on the bar, and the smaller coil of finer wire slides on the brass guides shown.

For methods of experimentation, and further description, see "Stewart & Gee's Physics," Lesson LXXII. This apparatus is suitable for illustration of magnetic distribution, referred to by Rowland in *Philosophical Magazine*, 1875, Vol. I., pages 257 and 348 . . . . . 10.00



1075

No. Price.

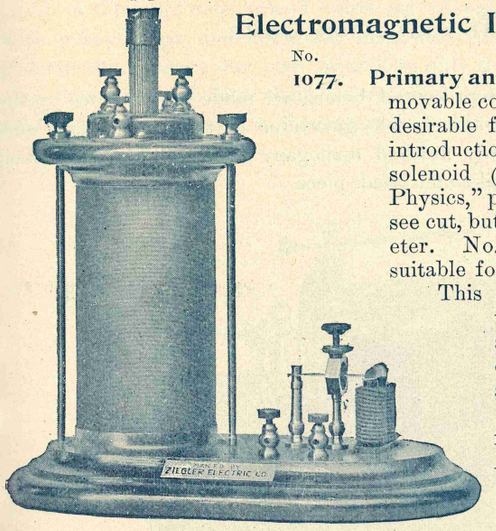
1075. Earth Current Inductor. For illustrating induction from earth's magnetic field. A circular coil, with a handle for revolving it, is pivoted in a rectangular frame, which is itself revolvable. The circular coil is connected by means of wires to binding posts on the rectangular frame, whence leads can be taken to the galvanometer.

A graduated dial is attached to one standard so as to indicate the inclination of the frame.

Made of well-seasoned hardwood, and handsomely finished (see "Stewart & Gee's Physics," Lesson LXX., and Gage's "Principles of Physics," page 551) $20.00

1076. Two cylinders of wood, each 10 ins. long, 3½ ins. diameter, with arrows painted on them to illustrate "Amperian" or molecular currents (Gage's "Principles of Physics," Sect. XVII.), per pair 1.00

Apparatus for Illustrating the Principle of Electromagnetic Induction.



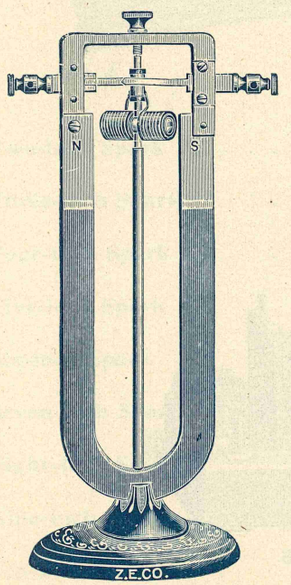
1077

No. Price.

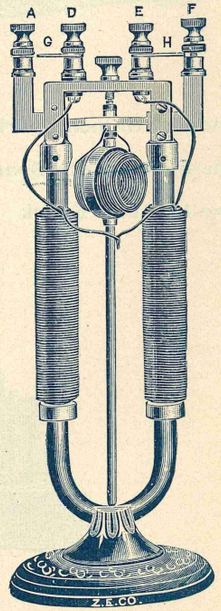
1077. Primary and Secondary Coils, with movable core of soft iron wire; very desirable for illustrating induction, introduction of movable core into solenoid (Gage's "Principles of Physics," page 546); improved style, see cut, but not including galvanometer. No. 950 is recommended as suitable for this experiment.

This set of coils is provided with an automatic make-and-break piece, so that it can be used for shocking and medical purposes . $9.50

For prices of handles for shocking purposes, see Accessories, page 201.



1078



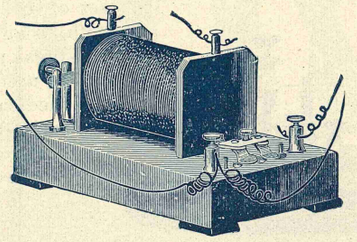
1079

1078. Apparatus, according to Page: A large permanent horseshoe magnet, with an electromagnet rotating freely on axis placed between its poles; requires but one cell of plunge battery . 6.00

1079. Apparatus with electromagnetic field and coil rotating on axis. Arranged for either shunt or series connection. One or two cells of plunge battery will suffice 7.50

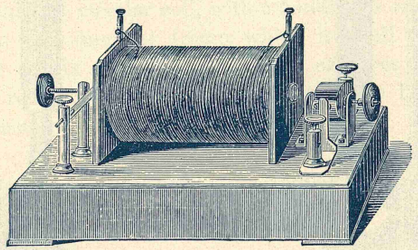
Ruhmkorff Induction Coils.

The Ruhmkorff Induction Coils, represented below, are made to our order by the very best French makers, and have the double guarantee of the makers and ourselves. They are mounted on highly finished mahogany bases, and are supplied with pole-changer and adjustable make-and-break piece.



1080—1082

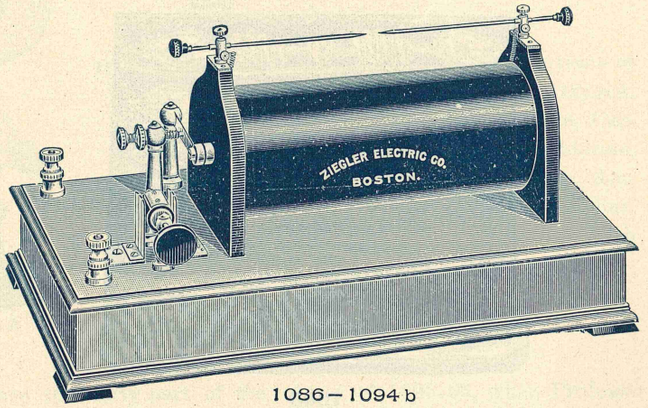
No.		Price.
1080.	One-eighth inch Spark	$3.00
1081.	One-quarter inch Spark	4.50
1082.	One-half inch Spark	8.50



1083—1085

1083.	Three-quarter inch Spark	13.00
1084.	One inch Spark	18.00
1085.	One and one-half inch Spark	28.00

All of the large coils priced below are of our own make, and each one is fitted with pole-changer and automatic make-and-break piece. Many new ideas and improvements, entirely our own, as well as only the very best material and workmanship, have entered into their construction. A pair of discharge-rods with hard rubber knobs, as shown in illustration, is included with each coil.



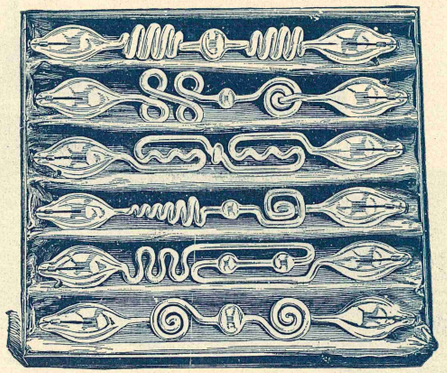
1086—1094 b

No.		Price.
1086.	Two-inch Spark	$34.10
1087.	Three-inch Spark	39.60
1088.	Four-inch Spark	46.20
1089.	Five-inch Spark	58.30
1090.	Six-inch Spark	79.70
1091.	Seven-inch Spark	99.00
1092.	Eight-inch Spark	112.20
1093.	Nine-inch Spark	125.40
1094.	Ten-inch Spark	145.20
1094a.	Eleven-inch Spark	159.00
1094b.	Twelve-inch Spark	172.00

A liberal discount will be allowed on any of the above-mentioned coils, if purchased in quantities.

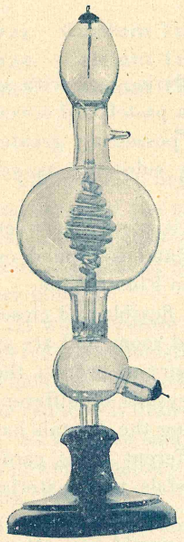
Geissler Tubes.

We carry in stock a large variety of very fine Geissler Tubes, which we offer at the exceedingly low prices appended. Each tube is fitted with metal caps for connections. When desired, we will endeavor to make the best selection for amount specified.



1095

No.		Price.
1095.	**Tubes,** 6 ins. long, various forms and colors, each	$ .75
1096.	**Set of Six Tubes,** 6 ins. long, same as No. 1095	4.00
1097.	**Tubes,** 8 ins. long, same as No. 1095, each	1.10
1098.	**Set of Six Tubes,** 8 ins. long, same as No. 1095	6.00
1099.	**Tubes,** 10 ins. long, same as No. 1095, each	1.25
1100.	**Set of Six Tubes,** 10 ins. long, same as No. 1095	7.00
1101.	**Tubes,** 6 ins. long, with different figures of Uranium glass enclosed within, each	1.10
1102.	**Set of Six Tubes,** 6 ins. long, same as No. 1101	6.00
1103.	**Tubes,** 8 ins. long, same as No. 1101, each	1.25
1104.	**Set of Six Tubes,** 8 ins. long, same as No. 1101	7.00
1105.	**Tubes,** 10 ins. long, same as No. 1101, each	1.40
1106.	**Set of Six Tubes,** 10 ins. long, same as No. 1101	8.00
1107.	**Double Tubes,** 6 ins. long, one within the other, inner one with bulbs, spirals, etc.; outer one filled with fluorescent solution, each	1.25
1108.	**Set of Six Double Tubes,** same as No. 1107	7.00
1109.	**Double Tubes,** 8 ins. long, „ „ No. 1107, each	1.40
1110.	**Set of Six Tubes,** 8 ins. long, same as No. 1107	8.00
1111.	**Double Tubes,** 10 ins. long, same as No. 1107, each	1.55
1112.	**Set of Six Tubes,** 10 ins. long, same as No. 1107	9.00



1113

No.		Price.
1113.	**Tubes on foot,** with Uranium spirals in bulb, 10 ins. high, each	$2.50
1114.	**Tubes on foot,** with Uranium fountains, spirals, bulbs, pitchers, or vases, 12 ins. high, each	3.50
1115.	**Spectrum Tubes.** Each tube has a trace of one of the following elements: Oxygen, Hydrogen, Nitrogen, Carbonic Oxide, Carbonic Acid, Iodine, Bromine, Chlorine, Fluoride of Boron, Chloride of Tin, Ammonia, Vapor of Water, Mercury, Sulphur, Selenium, and Sulphuret of Mercury. Each	2.25

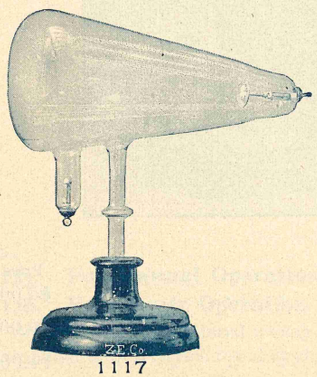
Crookes' Vacuum Tubes.

Ever since the early part of the winter of 1895–96, when Professor Roentgen first made known to the world his remarkable discovery, there has been an increasing demand for Crookes' tubes.

At the present time there seems to be various opinions amongst those who have used tubes of different forms as to which style is best suited for experiments with the X-Rays. The style of tube shown in illustration below is very popular, and gives excellent satisfaction.

We give prices on only a few different styles below, but will gladly, on application, quote prices on any desired form.

No.		Price.
1116.	**Crookes' High Vacuum Tube,** on stand, same style as one shown in illustration below, small	$5.00



1117

1117.	**Crookes' High Vacuum Tube,** on stand, same style as one shown in illustration below, large	8.00
1118.	**Crookes' High Vacuum Tube,** single reflecting, very fine	6.00
1119.	**Crookes' High Vacuum Tube,** long, cylindrical shape, unmounted	5.00
1120.	**Crookes' High Vacuum Tube,** double reflecting, large	15.00

All of our tubes are tested with the Fluoroscope, and are guaranteed to produce X-Rays.

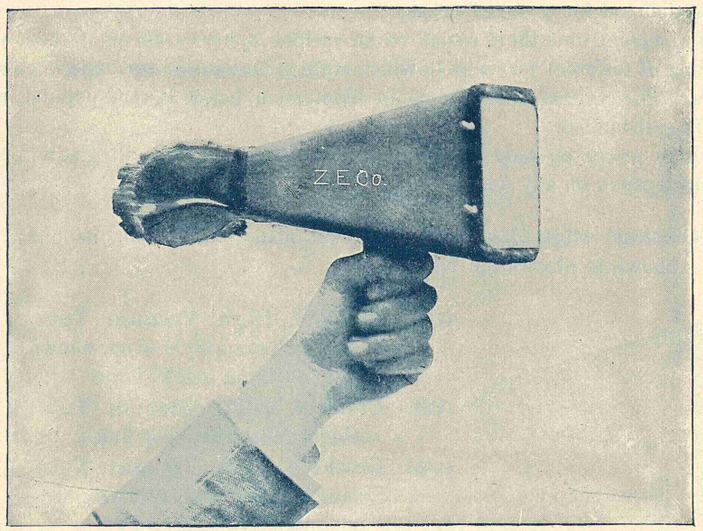
The Fluoroscope.

The Fluoroscope, as shown in illustration below, consists of a flaring box with an opening at one end to look into. The closed end is fitted with a pasteboard cover, on the inside of which is spread calcium tungstate, a material possessing greater fluorescent power, under the influence of the X-Rays, than any substance as yet known.

In use, the object to be observed (say, for instance, the hand) is placed between the excited tube and the screen. A shadow of the bones of the hand is formed on the latter, and can be observed by looking into the open end of the Fluoroscope.

Our Fluoroscopes are tasteful in design; they are provided with flexible and close-fitting eye-pieces, which make it possible to use them in a lighted room, and are as light in weight as is consistent with the strength of frame necessary to protect the screen. The screen is the result of careful experimenting with crystals of different sizes, and applied in varying quantities. The method of supporting the crystals has received special attention; after thorough tests of papers of different kinds, cardboards, woven cloths, aluminum foil, etc., as mounts for the crystals, that material has been adopted which proved best for the purpose.

An interesting experiment with the Fluoroscope, to which we would call attention, is performed by holding the instrument very near the source of X-Rays for a few minutes; it will be found that the screen retains the shadow cast on it for several seconds after the existing cause has been removed.



1121

No.		Price.
1121.	**Fluoroscope with Screen,** 3 ins. by 4 ins.	$6.00
1122.	**Fluoroscope with Screen,** 5 „ „ 5 „	10.00
1123.	**Fluoroscope with Screen,** 5 „ „ 7 „	14.00

No.		Price.
1124.	**Calcium Tungstate Screens** of any size, per sq. in.	$ .20
1125.	**Calcium Tungstate,** per gram	.20
1126.	**Calcium Tungstate,** „ oz.	6.50

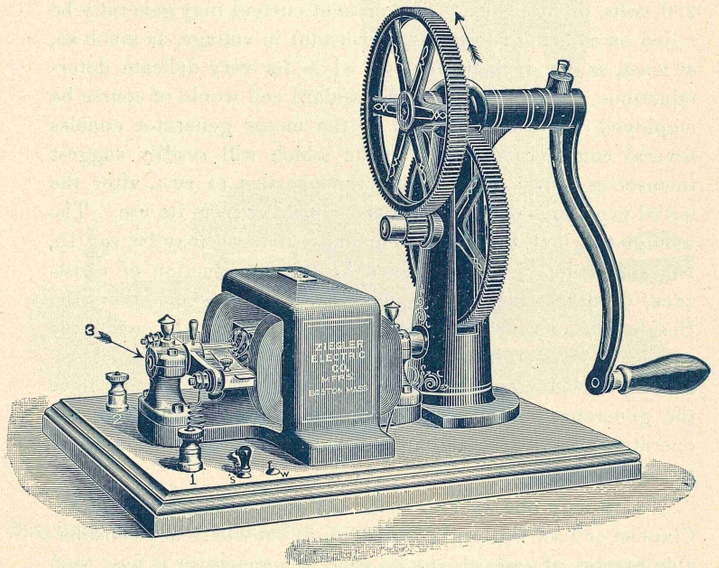
New Dynamo-Electrical Machine.

The machine depicted below has been especially designed by us for school work, and is one of the most approved types of modern dynamos. It is shunt wound and has the Siemens type of armature. A current of 4 amperes at an E. M. F. of 50 volts is produced by 2,160 revolutions of the armature, or 60 revolutions of the crank, per minute.

It will therefore permit of the employment of the ordinary 50 volt lamps of commerce for demonstration or experiment. A resistance in the base of the machine, which can be thrown into circuit by a switch, enables the output of the machine to be reduced if desired. It runs nicely as a motor on the 50 volt current.

As we have said of our Magneto-Electric Generator, No. 1130, it takes the place of a powerful battery (while offering none of its objectionable features) for electrolyzing, magnetizing electromagnets, operating electric motors, shocks, etc., and for developing heat and light.

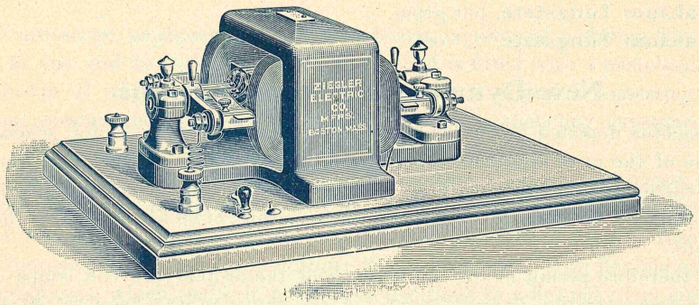
We also furnish this dynamo with pulley adapted to be operated by power where such is available. This is a thoroughly practical, strong, and well-made machine, and we can confidently recommend it.



1127

No.		Price.
1127.	**For Manual Operation**	$48.00
1128.	**For Power Operation**	46.00

NOTE. — At an additional outlay of $15.00, either of the machines mentioned above will be furnished with a device for changing the direct current to alternating.



1129

No. Price.

1129. Motor Generator or Rotary Continuous-Current Transformer.

The principle upon which this class of apparatus operates is of course familiar to every teacher of modern physics, and its great advantage is that it enables a current of very low voltage to be obtained without employing the troublesome, and sometimes offensive and dirty battery for that purpose, in such places as continuous current supply is obtainable, whether 500 volts, 220 volts, or 110 volts. This class of current may generally be relied on as being substantially constant in voltage, as much so, at least, as the ordinary battery, while for very delicate determinations, a properly prepared standard cell would of course be employed. The employment of the motor generator enables several combinations to be made which will readily suggest themselves to the teacher, and the question of cost, after the initial expense is disposed of, need not deter from its use. The voltage to which the outside current is reduced may be, say 10, 15, or 20 volts, or less, or varied by the introduction of resistance, or the connection of apparatus in series or otherwise. Besides this, a very moderate amount of wiring will enable the current to be used in several rooms, for bells, annunciators, fire-alarms, etc. In the laboratory, also, it would be easy to have the generator permanently connected to binding posts at the operating bench of each student, with which connection could be readily made.

Where only one or two cells are required, of course a Le-Clanche or Law Battery is all-sufficient, but where any considerable number of cells are to be used, the generator is now used in all commercial work such as telegraphy, telephony, protective alarm systems, etc., etc.

Machine as described above, 60 watt capacity . . . $60.00

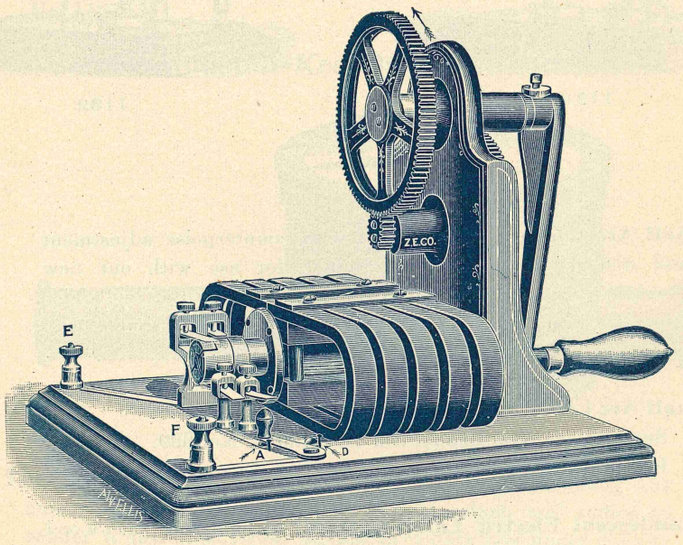
(Other sizes quoted on application.)

Magneto-electric Generator.

This is offered as an efficient and inexpensive generator to replace the troublesome voltaic battery in developing electric currents for purposes of school experimentation. In the language of a professor of electrical engineering in the Massachusetts Institute of Technology, "It answers well the purpose of developing currents for all ordinary lecture-room experiments, that is to say, for all purposes which do not require a current exceeding about 15 amperes."

A low voltage (approximately 10 volts with 60 revolutions of the crank per minute) is purposely employed. The armature is of the "drum" or Siemens's type.

The current is easily changed from alternating to direct, and *vice versa*. When two of these machines are connected, one may be used as a dynamo and the other as an electric motor, thus illustrating the reversibility of the dynamo. All the parts are purposely exposed to view, including particularly the commutator. The gearing, upright frame, and all working parts are made from heavy castings, and strict attention has been given to durability.



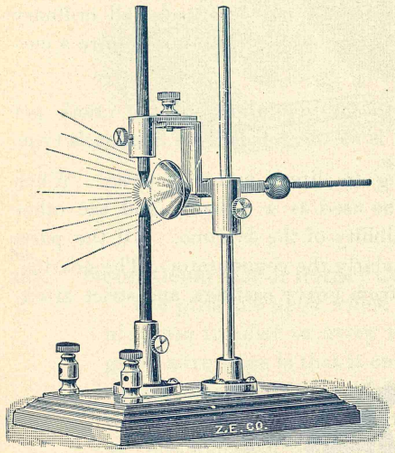
1130

No. Price.

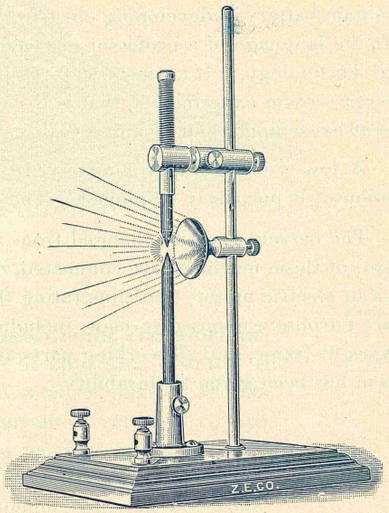
1130. Magneto-electric Generator, as described $28.00

For electrolyzing, magnetizing electro-magnets, operating electric motors, shockers, etc., and for developing heat and light, it takes the place of a powerful battery.

(See also our Dynamo Electric Machine, No. 1127 and Magneto Electrical Generator, No. 1138.)



1131



1132

No. Price.

1131. **Small Arc Lamp,** for illustration, with counterpoise adjustment and nickel-plated reflector. Suited for use with our new Dynamo Electrical machine, No. 1127, or Plunge Battery. This lamp is a near approach to the automatic form, is simple, and may be delicately adjusted $3.50

1132. **Small Arc Lamp,** cheaper form 2.50

See also our new Hand-Feed Arc Lamp, No. 699.

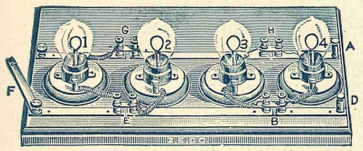
For prices of carbons for arc lamps, see Accessories, page 203.

1133. **Incandescent Electric Lamp System,** on polished hard-wood base, with switches for using lamps, either in multiple or series. For use with our Hand-Power Dynamo, No. 1127, or Plunge Battery, but without lamps (see illustrations on page 193) . 3.50

1134. **Incandescent Electric Lamp System** (same as No. 1133), with three mounted 6 candle-power lamps 8.00

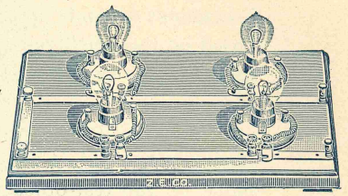
1135. **Incandescent Electric Lamp System** (same as No. 1133), with four mounted 6 candle-power lamps 9.50

Multiple-Arc.



1135

Series.



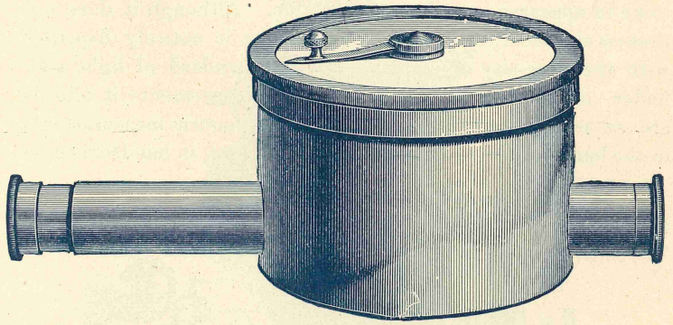
1135

Connect current wires to posts *A* and *D*. To light lamps 1, 2, 3, and 4 in series (see above illustration), open switches *E*, *B*, *G*, and *H*, and close switch *F*. To light lamps 1, 2, 3, and 4 in multiple arc (see above illustration), close switches *E*, *B*, *G*, and *H*, and open switch *F*.

No. Price.

1136. **Incandescent Electric Lamp,** 50 volt, 16 candle-power, mounted on neat hard-wood base, with binding posts for connections; very suitable for use with our new Dynamo Electric Machine, No. 1127 . . . . . $1.50

The Houston-Kenelly Illuminometer.



1137

1137. **This device** is based upon the principle of determining the amount of illuminated porcelain surface which will suffice to render a test-object just legible in a dark box under definite conditions. The feebler the light which illumines the porcelain surface, the larger the area of the surface which must be employed to render the test-object legible.

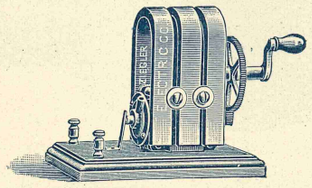
The instrument consists of a metallic cylindrical box, blackened on the inside and provided on its outer surface with a porcelain cover. Under a portion of this cover is an opening or window in a brass sheet, while a slide or shutter moves over this window under the control of a pointer situated above the cover. By moving this pointer, the aperture of the window

No. Price.

can be varied from zero to the full opening of the window. The instrument depends upon the visual power of each individual, based on the sensitiveness of the retina. It is found that while the lecticular adjustment of different eyes varies considerably, the retinal sensibility is much more uniform, so that when the eye has been focussed with the aid of the eye-piece and draw-tube, and test-object placed in the dark box, the limit of legibility of the test-object is very nearly the same for all normal eyes.

The apparatus will be found to be of value not only to electrical engineers, but also to all users and purchasers of light. It requires no special training in its use, and every one employing such an instrument can ascertain whether the illumination he receives upon a table or reading desk is adequate for the purpose of convenient and healthful reading. Moreover, by its use, any single lamp can be tested for candle power by measuring the full illumination produced by said lamp at a measured distance.

We believe this instrument will supply a long-felt want, since it will place in the hands of the public the means for obtaining an estimate of the light they purchase. The instrument is handsome in appearance, light and portable. Although it does not possess the accuracy of a photometer, yet it entirely dispenses with the necessity of carrying about a standard of light, and, under ordinary circumstances, the measurements it affords are as nearly accurate as would be photometric measurements in the hands of the ordinary individual. Price, in handsome case $15.00

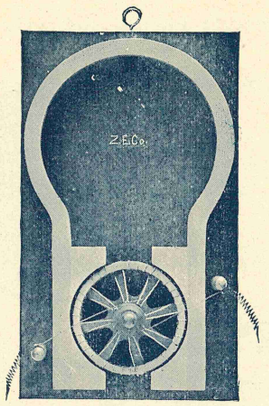


1138

1139

1138. Magneto-electrical Generator, with three permanent magnets and Siemens's drum armature. Will give shocks, ring bells ten miles distant, etc. Can be used for medical purposes. Since magnetos and dynamos are rapidly replacing the voltaic battery, every laboratory should be provided with apparatus of some kind suited to illustrate this method of developing electric energy 5.00

1139. Bell to accompany the last, acting on the principle of Siemens polarized armature, showing the to-and-fro action of the current (no other bell will answer) 2.50

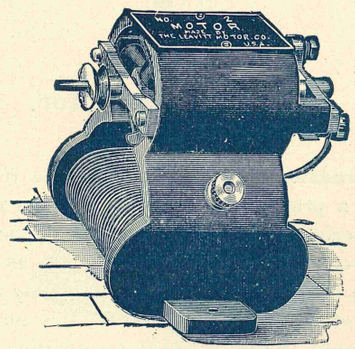


1140

No. Price.

1140. Model of the Gramme Machine, showing all the essential details of its mechanism. Diagrams and perspective views fail to give the pupil a complete grasp of this important machine. With the diagram and description given in Gage's "Principles of Physics," page 565, and this model before him, the dullest pupil cannot fail to comprehend the whole $3.50

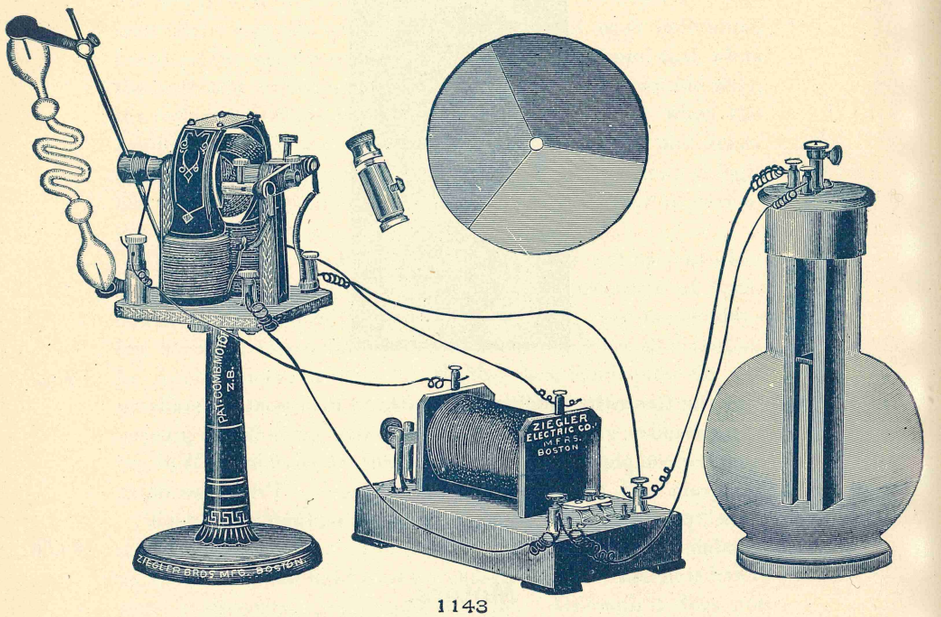
Motors.



1141

1141. Small Motor (selected as, in our opinion, the *best* inexpensive motor now on the market, subject to change when a better appears). No. 1 ($3.00), with 2 volts, will run efficiently a 5 in. fan, toy turntable, etc.; No. 2 ($5.00), with 4 volts, 3 amperes, will run an 8 in. fan; No. 3 ($10.00), 6 volts, 7 amperes, is an efficient sewing-machine motor, and develops $\frac{1}{12}$ horse power, running at 2,200 revolutions per minute; No. 4 ($15.00), rated at $\frac{1}{8}$ horse power, recommended for sewing-machine work and for fans. Will operate on circuit of 10 volts or less. All the motors are self-starting.

1142. Fans for above, extra; 5 ins., 35 cts.; 6 ins., 50 cts.; 7 ins. .60



1143

Combination Motor.

No. Price.

1143. Our New Combination Motor, represented in the above cut, is not a toy but a practical machine, and is the result of long and careful experiments. It is made with the same care and precision and regards to scientific principles as are used in the construction of the best large motors. Only the very best material and workmanship are put into this motor. As its name would imply, it can be used for rotating a variety of articles, such as fans, color discs, Geissler tubes, small siren discs, turn-tables, etc. The attachment for Geissler tubes will carry any tube not over 12 ins. in length.

Various optical phenomena are brought out, and a magnificent display is produced by causing the Geissler tubes to rotate with different degrees of velocity and by altering the frequency of the discharge of the current. It requires very little battery power. The current from a one quart cell of the ordinary plunge battery is sufficient to run same with great speed. Price, including attachment for Geissler tubes and clamp for inserting color discs $9.00

No. Price.

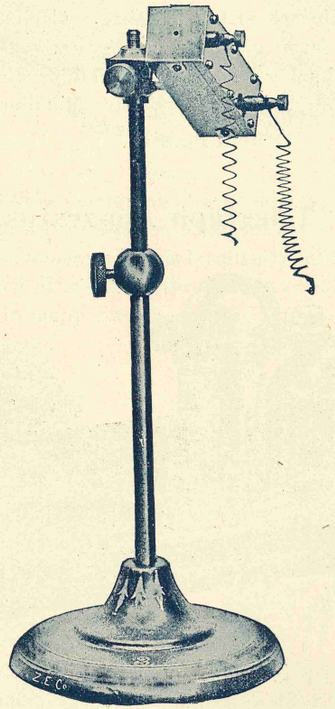
1144. Motor same as No. 1143, but without Geissler Tube Attachment or Clamp $7.00

For prices of batteries, coils, etc., see under those headings.

NOTE.—No. 1144, wound to operate on 110 volt circuits with incandescent lamp in series mounted on top of the motor $10.00.

1145. Electric Railway, working model, of simplest kind, complete, with two cells of the Grenet battery 12.00

Thermo-piles for Purposes of Demonstration.



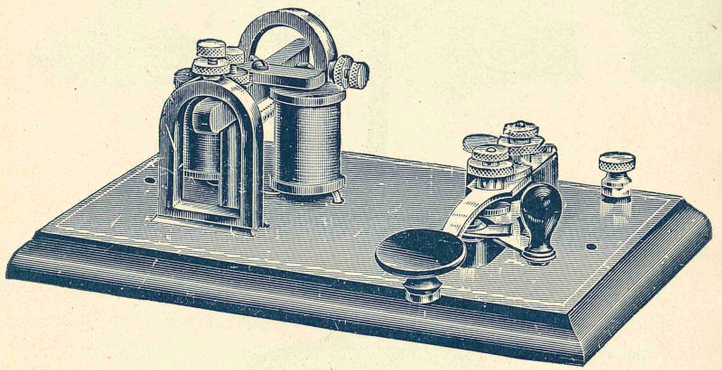
1146

1146. Thermo-pile; consists of sixteen pairs of antimony and bismuth bars, nicely encased in hard rubber mounting, and fitted to a stand for adjustment of position, with binding posts for connections.

This instrument, connected with our Astatic Galvanometer, No. 950 (or any very sensitive galvanometer), constitutes an exceedingly delicate thermoscope and thermometer. The heat of a person's breath, if applied at one of its ends, will show a large deflection of the galvanometer needle. It must meet a long-felt want by teachers and others for an inexpensive and sensitive thermo-pile. Price, not including galvanometer . 15.00

No.		Price.
1147.	**Thermo-electric V,** pair of bismuth and antimony bars on adjustable stand	$4.00
	Larger or more elaborate piles made to order.	
1148.	**Apparatus for Electrotyping.** Complete set, consisting of large glass jar, moulding-case, copper plate for positive electrode, prepared wax, plumbago, brush for plumbagoing, sheet rubber, iron filings, sulphate of copper, etc. (see full directions for electrotyping in Gage's "Physical Technics")	3.00
1149.	**Apparatus for Electro-nickel Plating.** Complete set, consisting of battery, large glass jar, connecting rods and wire, two gallons of nickel solution, one nickel anode, with polishing compounds, and a copy of Watt's "Electro-Metallurgy" . .	8.00

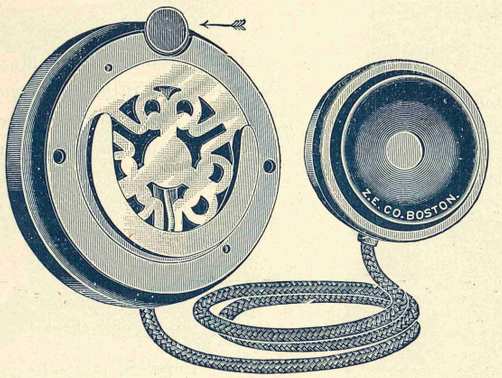
Telegraph Apparatus.



1150

1150.	**Student's Outfit,** perfect sounder and key, mounted together on an iron base, with battery	4.00
1151.	**Student's Outfit,** without battery	3.25
1152.	**Telegraph Sounder and Key,** mounted together on a neat wooden base, making a compact, practical, and effective combination set for learners	2.00
1153.	**Complete Set of Telegraph Apparatus,** consisting of two sounders, two keys, and a relay (good working instruments, no worthless toys), each mounted separately	13.00
1154.	**Sounder and Key,** as in No. 1153	5.00
1155.	**Relay** as in No. 1153	4.00

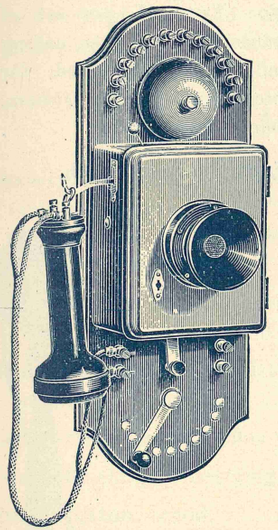
Telephones.



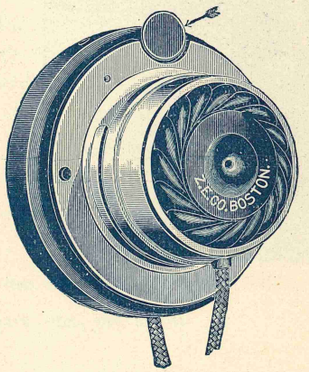
Type S.

In large educational establishments, and especially those in which the buildings are more or less scattered, some means of communication other than that furnished by bells is often a great convenience, and is frequently indispensable.

The old-fashioned method of speaking through tin tubes is rapidly lapsing into an innocuous desuetude, and in many cases is entirely inapplicable.

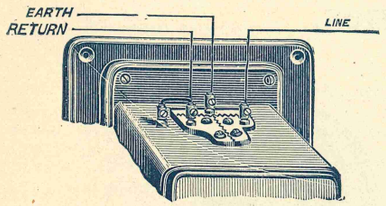


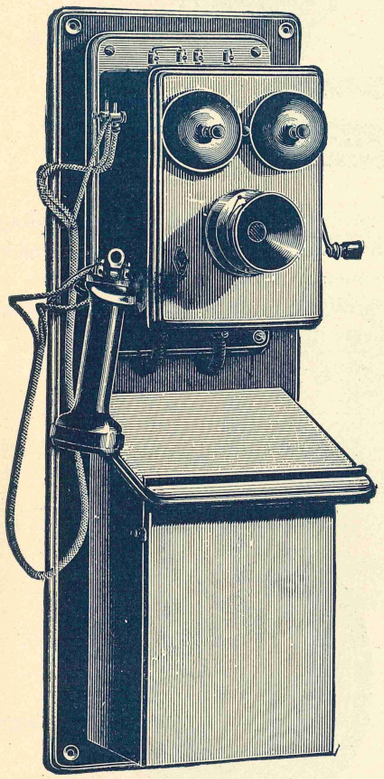
Type H.



Type S.

Having regard to the demand for some better form of intercommunication, where the very lowest initial cost is not the controlling element, we are prepared to offer an electric telephone system which can be installed at a reasonable cost, and which will afford a means of communication superior to any other, either from the principal's room to the various class-rooms, janitor, laboratory, etc., etc., or among the different rooms interchangeably.

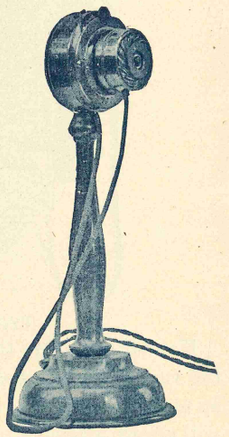




1161 Type Z.

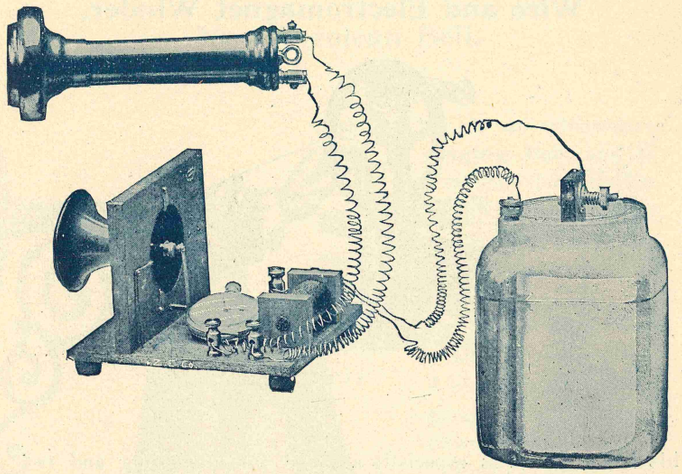
It is manifestly difficult to make any definite and intelligent quotation on cost of such an installation without information as to the conditions in each case, but we are prepared, at any time, to answer any questions on the subject, and to submit prices, on being furnished with the necessary data.

No.		Price.
1156.	**Type S**, per set, comprising transmitter and receiver .	$9.00
1157.	**Type S**, desk pattern, comprising transmitter and receiver, on upright stand, per set	12.50
1158, 1159.	**Type H**, per set of transmitter, receiver, calling bell, and switchboard, for intercommunicating system, four contacts or less . .	16.00
1160.	**Extra Contacts**, each .	.50



1157
Desk Pattern, Type S.

1161. **Type Z**, per set, consisting of transmitter, receiver, magneto generator, induction coil, polarized armature bells, lightning arrester, ground-line connection, battery box and writing tablet, net . . . 18.00



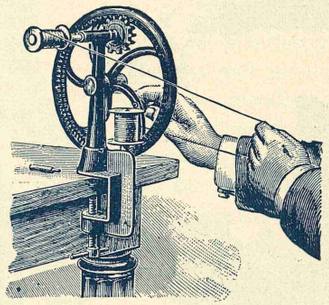
1162

No.		Price.
1162.	**Microphone**, improved form, with induction coil and hard rubber mouthpiece; can also be used for shocking purposes. This is a very sensitive and nicely constructed instrument. Price, including telephone receiver and battery	$5.75

Accessories.

1163.	**Battery Connectors**, a new device for joining voltaic pairs in multiple arc (see Gage's "Laboratory Manual," Exs. 128, 130, 131, 132, 133, and 134), substitute for mercury cup, no danger from upsetting, each	.25
1164.	**Glass Insulators**, with wooden screw pegs, used in constructing insulated stools, per set of four	.35
1165.	**Brass Handles**, nickel-plated, used in giving shocks, very neat, per pair	.60
1166.	**Conducting Cords**, of fine wires, for use with No. 1165, per pair	.40
1167.	**Tin Foil**, thin, for covering Leyden jars, etc., per sheet . .	.10
1168.	**Push Button**, wood	.15
1169.	**Push Button**, metal	.30
1170.	**Push Button**, bronze	.60
1171.	**Desk Push Button**	.35
1172.	**Switch**, one-point, on neat, round, hard-wood base . . .	.20
1173.	**Switch**, two-point, „ „ „ „ „	.25

Wire and Electromagnet Winder.



1174

No. Price.

1174. **This instrument** is especially adapted for unwinding and rewinding small electromagnets.

The engraving represents a magnet being wound from a spool of wire, which turns on a stud projecting from the clamp. A hub, like that shown lying on the table, is used to support the magnet, one end of the hub screwing in the thread of the magnet core. The spool and magnet hubs are interchangeable.

To unwind a magnet, it is placed on the stud shown occupied by the spool, and the latter is screwed on the spindle. The operation of winding is clearly shown by the illustration . . $3.50

1175. ***Same as No. 1174,*** nickel-plated 4.50

1176. **Electric Call-Bell Outfit,** consisting of two "Gonda" LeClanche cells, complete (see No. 918), one metal push button, one "Leader" wood box bell, and 200 ft. No. 18 annunciator wire, with one box double-pointed tacks, all securely packed in box ready for shipment 4.25

This is high-grade material and not to be confounded with the electric bell outfit, No. 1177, sold at $2.50.

1177. **Electric Call-Bell Outfit,** one cell of battery, one wood push button, one iron box bell, 100 ft. wire with tacks, packed for shipment, cheaper outfit. This is an outfit which we put up practically at cost for the benefit of young experimenters, and is all reliable material, though of course not quite as good as that last listed 2.50

1178. **Leader Wood Box Bell,** 2½ ins., best quality 1.00

1179. **Leader Wood Box Bell,** 3 „ „ „ 1.05

New Tyrolean Bell.

1180

No. Price.

1180. **This is a continuous ringing Bell,** and is especially desirable for use in school halls for announcing the opening and closing of recitations.

From a handsome bracket is suspended a 4 in. nickel-plated tea gong, having a very clear and loud tone.

Inside of the gong is attached a well-made vibrating mechanism which requires for its operation two cells of battery.

Ornamental as well as useful . . . $3.50

1181. **Pressed Carbons,** for battery and other purposes.

Inches,	3 x 2 x ¼,	4¼ x 1⅜ x ¼,	6 x 1⅝ x 5/16.
Price,	$ .05	$ .06	$ .07 each.
Inches,	7 x 1½ x ¼,	7 x 4½ x ½,	8 x 5¾ x ¼.
Price,	$ .08	$ .30	$ .35 each.
Inches,	9 x 2 x ⅝,	9 x 6 x ¼,	10 x 6 x ¼.
Price,	$ .30	$ .40	$ .40 each.
Inches,	10 x 6 x ½,	11 x 6 x ½,	12 x 6 x ¼,
Price,	$ .55	$ .75	$ .80 each

1182. **Carbon Pencils,** for arc light and experimental purposes.

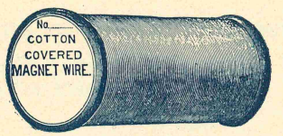
Prices for 12 in. lengths.

Diameter,	3/16 in.	¼ in.	5/16 in.	⅜ in.	7/16 in.	½ in.
Price,	$ .12	$ .10	$ .08	$ .06	$ .05	$ .05 each.

1183. **Snapper Sounder;** a handy mechanical telegraph instrument, for practise in sending and reading the Morse alphabet by sound. Can be carried in the vest pocket 25

Bare Copper, Spring Brass, Iron, and German Silver Wire.

No.		Price.
1184.	**Copper Wire,** soft, No. 16 B. & S. Gauge, per 1 lb., on spool	.35
1184.	**Copper Wire,** „ „ 18 „ „ „ 1 „ „ „	.40
1184.	**Copper Wire,** „ „ 20 „ „ „ ¼ „ „ „	.25
1184.	**Copper Wire,** „ „ 20 „ „ „ ½ „ „ „	.40
1184.	**Copper Wire,** „ „ 20 „ „ „ 1 „ „ „	.70
1184.	**Copper Wire,** „ „ 23 „ „ „ ¼ „ „ „	.30
1184.	**Copper Wire,** „ „ 23 „ „ „ ½ „ „ „	.50
1184.	**Copper Wire,** „ „ 23 „ „ „ 1 „ „ „	.85
1184.	**Copper Wire,** „ „ 25 „ „ „ ¼ „ „ „	.33
1184.	**Copper Wire,** „ „ 25 „ „ „ ½ „ „ „	.55
1184.	**Copper Wire,** „ „ 25 „ „ „ 1 „ „ „	.90
1184.	**Copper Wire,** „ „ 27 „ „ „ ¼ „ „ „	.34
1184.	**Copper Wire,** „ „ 27 „ „ „ ½ „ „ „	.58
1184.	**Copper Wire,** „ „ 27 „ „ „ 1 „ „ „	.95
1184.	**Copper Wire,** „ „ 30 „ „ „ ¼ „ „ „	.35
1184.	**Copper Wire,** „ „ 30 „ „ „ ½ „ „ „	.60
1184.	**Copper Wire,** „ „ 30 „ „ „ 1 „ „ „	1.05
1185.	**Spring Brass Wire,** „ 25 „ „ „ ¼ „ „ „	.20
1185.	**Spring Brass Wire,** „ 25 „ „ „ ½ „ „ „	.35
1185.	**Spring Brass Wire,** „ 25 „ „ „ 1 „ „ „	.65
1185.	**Spring Brass Wire,** „ 27 „ „ „ ¼ „ „ „	.25
1185.	**Spring Brass Wire,** „ 27 „ „ „ ½ „ „ „	.40
1185.	**Spring Brass Wire,** „ 27 „ „ „ 1 „ „ „	.75
1185.	**Spring Brass Wire,** „ 30 „ „ „ ¼ „ „ „	.30
1185.	**Spring Brass Wire,** „ 30 „ „ „ ½ „ „ „	.55
1185.	**Spring Brass Wire,** „ 30 „ „ „ 1 „ „ „	1.00
1186.	**Annealed Iron Wire,** No. 24 „ „ „ ¼ „ „ „	.18
1186.	**Annealed Iron Wire,** „ 24 „ „ „ ½ „ „ „	.30
1186.	**Annealed Iron Wire,** „ 24 „ „ „ 1 „ „ „	.50
1186.	**Annealed Iron Wire,** „ 25 „ „ „ ¼ „ „ „	.20
1186.	**Annealed Iron Wire,** „ 25 „ „ „ ½ „ „ „	.37
1186.	**Annealed Iron Wire,** „ 25 „ „ „ 1 „ „ „	.70
1186.	**Annealed Iron Wire,** „ 30 „ „ „ ¼ „ „ „	.25
1186.	**Annealed Iron Wire,** „ 30 „ „ „ ½ „ „ „	.40
1186.	**Annealed Iron Wire,** „ 30 „ „ „ 1 „ „ „	.70
1187.	**German Silver Wire,** soft, No. 28, B. & S. Gauge, per ¼ lb., on spool	.72
1187.	**German Silver Wire,** soft, No. 28, B. & S. Gauge, per ½ lb., on spool	1.25
1187.	**German Silver Wire,** soft, No. 28, B. & S. Gauge, per 1 lb., on spool	2.25
1187.	**German Silver Wire,** soft, No. 30, B. & S. Gauge, per ¼ lb., on spool	.90
1187.	**German Silver Wire,** soft, No. 30, B. & S. Gauge, per ½ lb., on spool	1.60
1187.	**German Silver Wire,** soft, No. 30, B. & S. Gauge, per 1 lb., on spool	2.90
	Subject to fluctuations in market.	
1188.	**Annunciator Wire,** Nos. 16 and 18, B. & S. Gauge, per lb.	.30
1189.	**Office Wire,** Nos. 16 and 18, B. & S. Gauge, per lb.	.33



Price per pound Copper Magnet Wire — wound with Cotton or Silk.

Cat. No. 1190

SIZE NUMBER. B. & S. GAUGE.	COTTON.		SILK.	
	SINGLE.	DOUBLE.	SINGLE.	DOUBLE.
16			$1.12	$1.53
18			1.15	1.57
23	$ .83	$1.05	1.42	1.93
24	.90	1.14	1.56	2.13
28	1.35	1.69	2.38	3.23
30	1.65	2.07	2.95	4.02
31	1.80	2.23	3.25	4.40
34	2.85	3.42	4.10	5.30
36	4.37	4.93	7.00	8.88
38	9.00	9.50	13.00	14.50

For price per ounce, add twenty-five per cent. to above.

Price per pound German Silver Magnet Wire — wound with Cotton or Silk.

Cat. No. 1191

SIZE NUMBER. B. & S. GAUGE.	COTTON.		SILK.	
	SINGLE.	DOUBLE.	SINGLE.	DOUBLE.
16	$1.40	$1.70	$1.85	$2.38
18	1.40	1.70	1.85	2.38
23	1.62	1.98	2.21	2.87
24	1.71	2.09	2.37	3.08
28	2.45	2.98	3.42	4.43
30	2.84	3.38	4.14	5.33
31	3.09	3.66	4.52	5.81
34	4.61	5.44	5.84	7.29
36	8.09	8.88	10.00	11.75
38	24.00	27.00	28.00	33.00

For price per ounce, add twenty-five per cent. to above.

Prices on any other size or kind of wire, not given in the preceding lists, given on application.

The preceding lists comprise only small selections.

Price-List of Binding Posts, Connectors, etc.

Cat. No. 1192.

All of our binding posts, connectors, etc., are accurately made with special tools from the best material. By manufacturing in large quantities we are able to supply them at prices which will compare favorably with those commonly charged for similar articles of inferior material and workmanship.

When ordering binding posts, state whether screws and washers are wanted or not. If screws are wanted, state the kind and length (whether wood or machine, round or flat headed screws).

At an additional expense of one cent for each binding post, a screw of any kind or size, together with either one or two washers (as wanted) to fit, will be supplied.

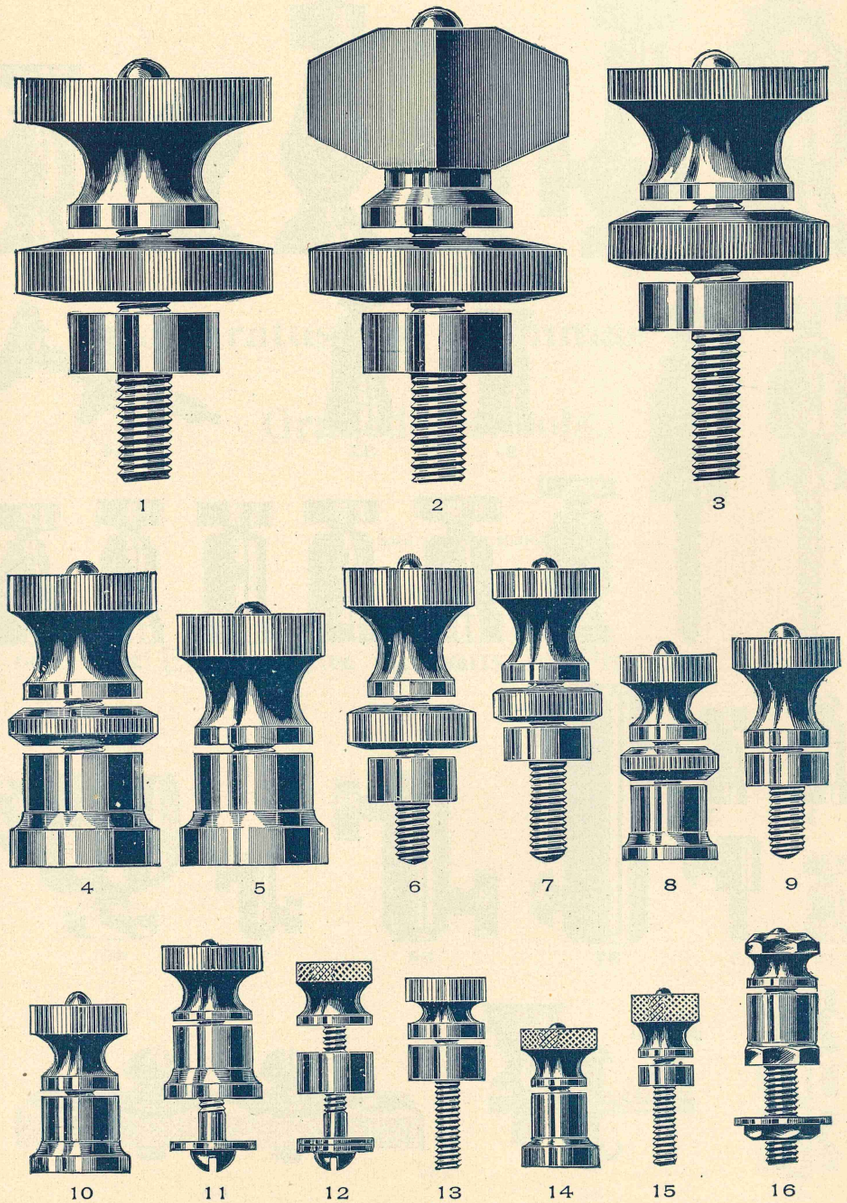
Each article priced below is represented full size in illustrations on pages 207 and 208.

No.	Each.	No.	Each.
1	$ .75	24	$ .10
2	1.00	25	.08
3	.75	26	.08
4	.25	27	.08
5	.22	28	.08
6	.22	29	.08
7	.20	30	.08
8	.14	31	.08
9	.12	32	.08
10	.10	33	.07
11	.10	34	.08
12	.07	35	.10
13	.08	36	.06
14	.08	37	.15
15	.08	38	.10
16	.08	39	.09
17	.20	40	.12
18	.16	41	.10
19	.10	42	.16
20	.12	43	.12
21	.08	44 (without plat. tip)	.06
22	.08	45 (with plat. tip)	.20
23	.10		

Special prices quoted on any of the above in quantities.

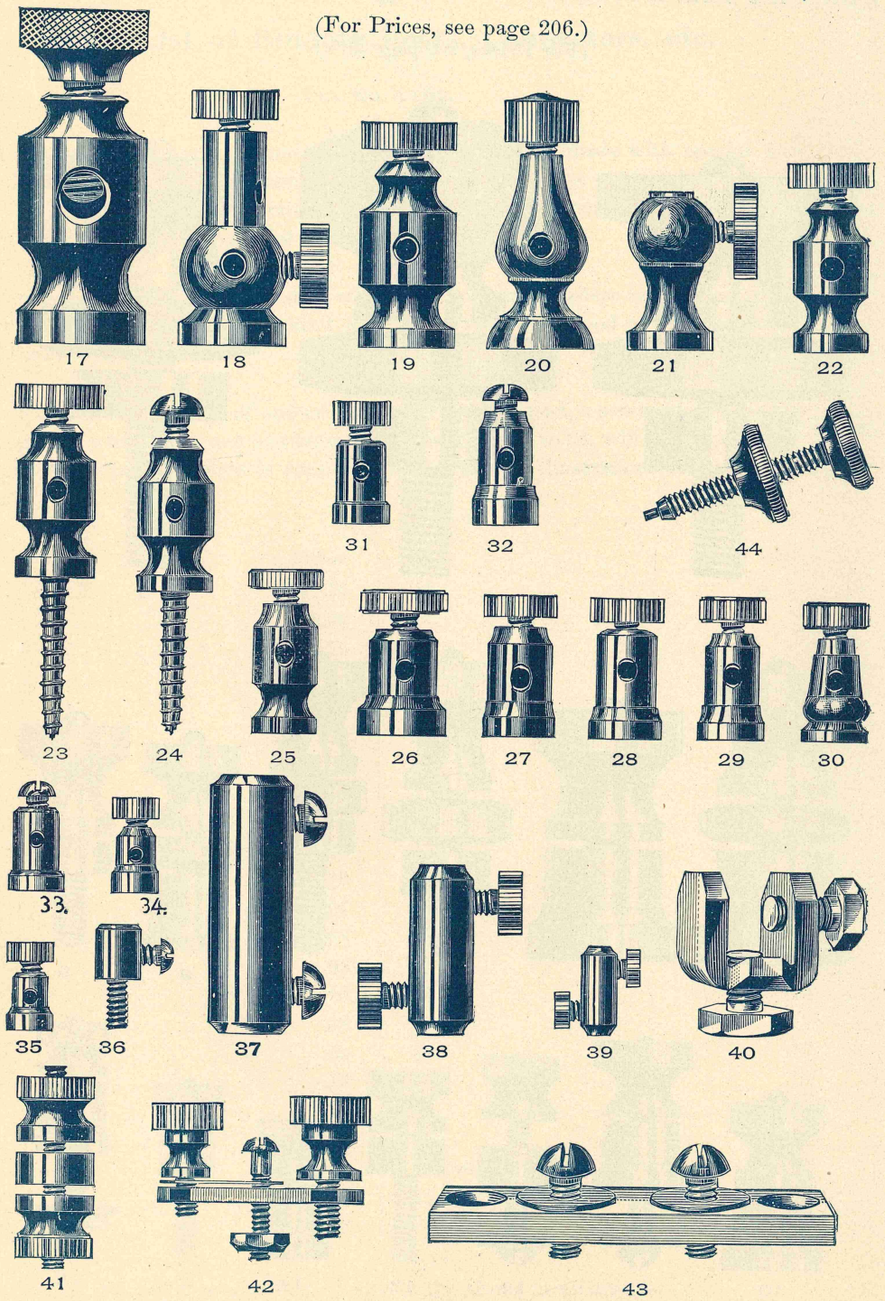
Full-Size Illustrations of Binding Posts, Connectors, etc.

(For Prices, see page 206.)



Full-Size Illustrations of Binding Posts, Connectors, etc.

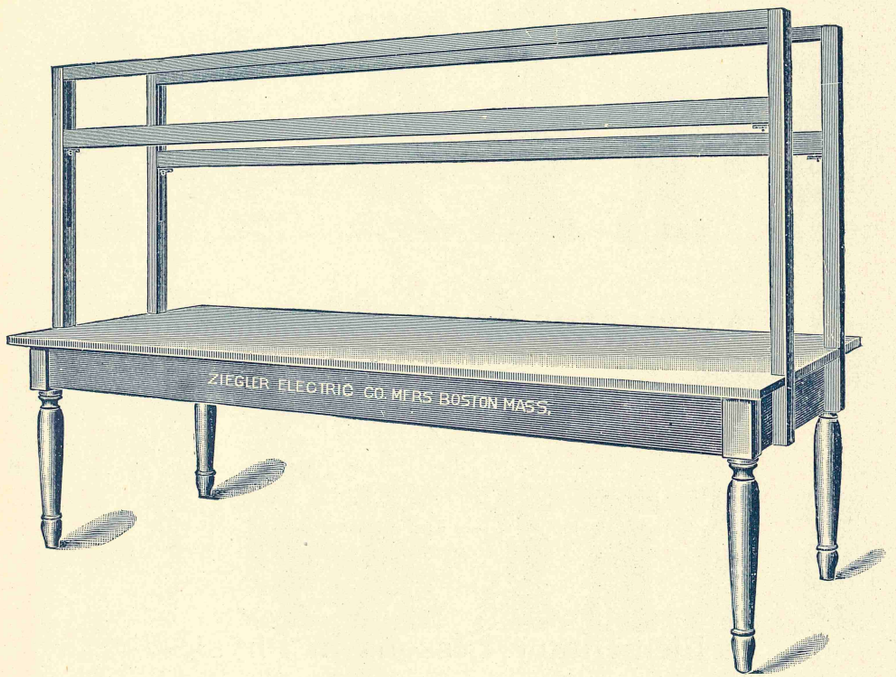
(For Prices, see page 206.)



Apparatus for Grammar and Graded Schools,

To be used with Dr. Hall's

"Elementary Lessons in Physics."



Laboratory Table.

Many inquiries have reached us concerning a suitable Physical Laboratory Table. For the benefit of such parties and others who may be interested, we would state that we know of no better table than the one used in the grammar schools of Cambridge, Mass. This table is shown in above illustration, and we give the following brief description of same :—

The table is about 10 ft. long, 4 ft. wide, and 2 ft. 10 ins. tall ; has white pine top, about 1½ ins. thick, and heavy whitewood legs. Extending from end to end over the table are two horizontal bars, about 2 ins. by 3 ins., adjustable at various heights (which should range from 1½ ft. to 3½ ft., by 3 in. intervals) above the table top, their ends, which are cut in tenons, sliding in grooves in the supporting posts. These posts are fastened to the frame of the table, and rise through slots in the table top, being flush with the ends of this top, and about 10 ins. distant from the sides. Pins of iron or wood, placed in holes in these posts, support the ends of the horizontal bars.

Elementary Lessons in Physics.

To Teachers of Physics : —

The apparatus mentioned in the appended lists is intended for use in connection with Dr. E. H. Hall's "Elementary Lessons in Physics."

In the preparation of the apparatus to accompany this book, we have endeavored to include articles of the best possible adaptation and quality.

For valuable suggestions and aid in our efforts we are deeply indebted to Dr. Hall.

The "Committee of Ten" urgently recommend in their report that elementary physics be taught in the higher classes of grammar or graded schools, so that the majority of pupils, whose formal education ends at this grade, may have a general knowledge of important physical laws, or that those who are to continue the study in the higher classes may be better fitted.

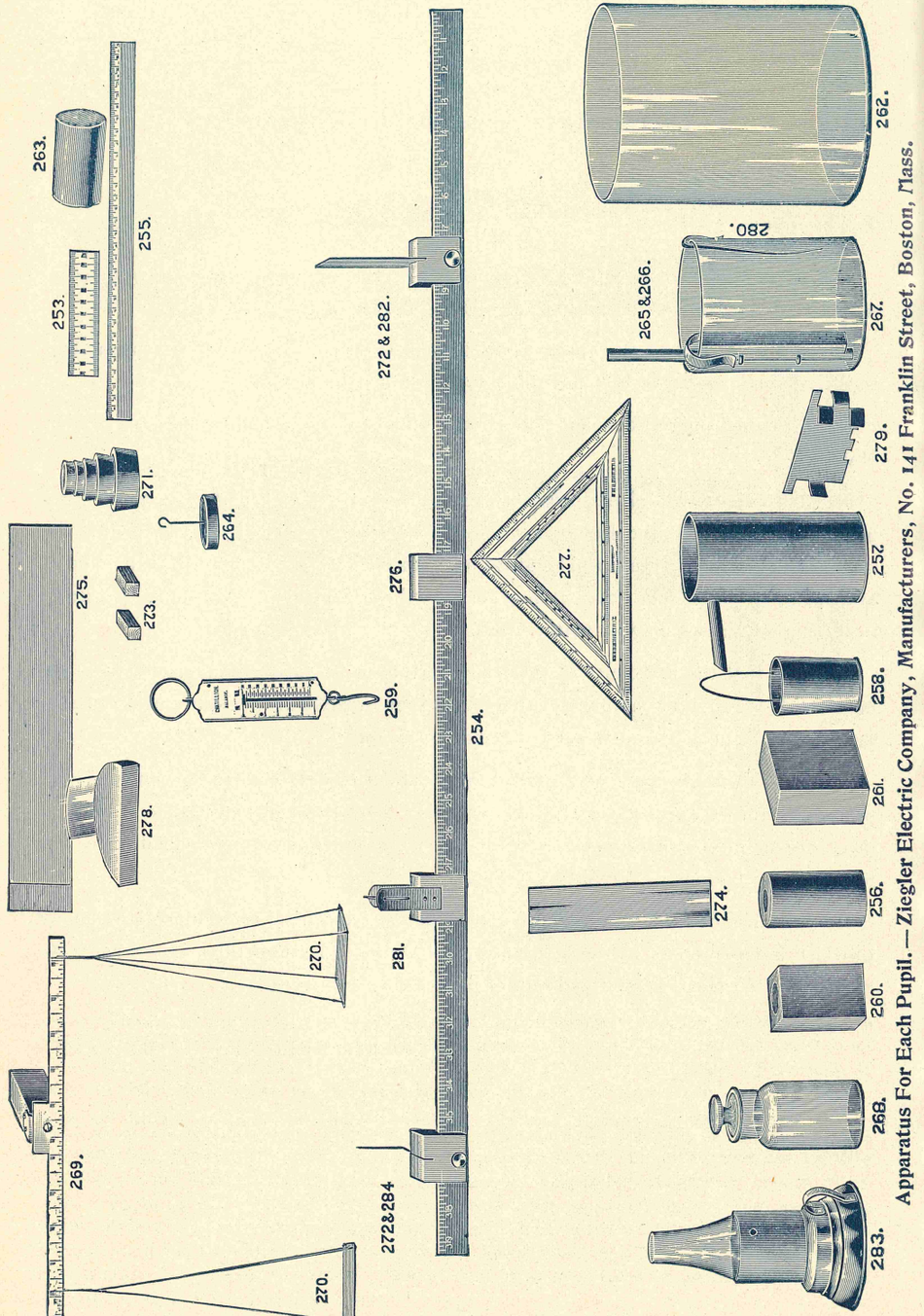
In order that the principles of the study may be most clearly enunciated, Dr. Hall believes that "an equal amount of time should be devoted to the study of physics in the laboratory proper, and lecture or recitation room."

The laboratory exercises of this book cover about one-third of the ground covered by the laboratory exercises of Hall & Bergen's "Text-Book of Physics," and most of them are in close correspondence with the work in physics recommended by the report of the famous "Committee of Ten."

Dr. Hall has devised two sets of apparatus: one intended for the use of students working independently in the laboratory, the other for lecture-room experiments, to be used by the teacher, and made up of more expensive pieces.

ZIEGLER ELECTRIC COMPANY.

☞ Hall's "Elementary Lessons in Physics" will be sent, postpaid, to any address on receipt of 75 cents.



Apparatus For Each Pupil. — Ziegler Electric Company, Manufacturers, No. 141 Franklin Street, Boston, Mass.

Price-List

Of Apparatus for Experiments in "Elementary Lessons in Physics."

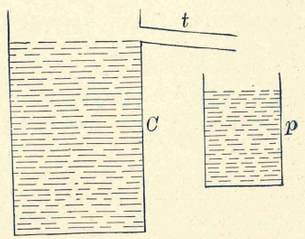
Laboratory Outfit.

NOTE.— This list constitutes a set of apparatus required for each pupil. Price of set, complete, $6.00.

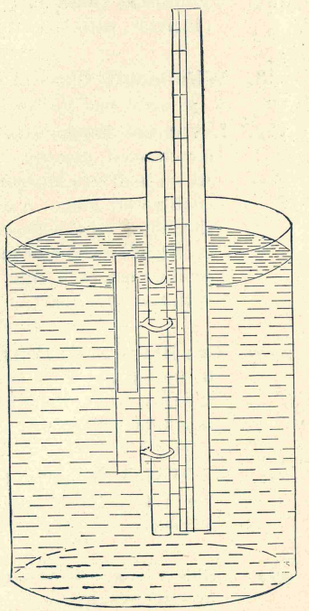
Single pieces of apparatus will be furnished at the prices affixed to such articles.

When ordering single pieces, please order by number.

No.		Price.
253.	**Ten-centimeter section of a Meter-rod.** Each	$ .05
254.	**Meter-rod,** metric divisions on one side and English divisions on the other	.25
255.	**Metric rule,** 30 centimeters long, graduated on one side into millimeters and on the other into eighths of an inch. Each	.10
256.	**Wooden Water-proofed Cylinder,** 8 centimeters long, 4.5 centimeters in diameter, loaded with shot so that it will float nearly submerged in water. After having been dipped in hot paraffin, each cylinder is placed under the receiver of an air-pump and the air exhausted. In consequence of this operation it remains water-proofed much longer, and its surface is made very smooth. Each	.25
257.	**Brass Can,** 14 centimeters tall and 7 centimeters in diameter, with slightly declining overflow tube. Each	.40
258.	**Brass Catch-bucket,** with wire handle, holding about 175 grams water. Each	.20



257 258



262, 265, and 266

No. Price.

259. Spring Balance, graduated on one side in 10 gram intervals, and on the other side in ½ ounce intervals. Capacity, 8 ounces to ½ ounce, or 250 grams to 10 grams. Each . . . . . $ .55

260. Rectangular Water-proofed Block of Wood, 7 centimeters long and 4.5 centimeters square on the end, so loaded internally with shot that it will sink in water, weighing about 225 grams. This block is treated in the same manner as was No. 256, after having been dipped in hot paraffin. Each 25

261. Rectangular Water-proofed Cherry Block, about 7.5 centimeters by 3.8 centimeters. The surfaces of this block are smooth, having been treated in the same manner as was No. 256. Each 25

262. Battery Jar, good quality, 6 ins. x 8 ins. Each 30

263. Lump of Roll-sulphur, weighing about 175 grams. Each 05

264. Lead Sinker, with wire handle, weighing about 175 grams. Each . . .15

265. Water-proofed Wooden Cylinder, 1 centimeter in diameter, 20 centimeters long. This rod is treated in the same manner, after being dipped in hot paraffin, as was No. 256. Each 06

266. Holder for keeping No. 265 upright in water, nicely constructed. Each . .20

267. Cylindrical Glass Jar, about 14 centimeters tall and 10 centimeters in diameter, with level top. Each 12

268. Wide-mouth Glass-stoppered Bottle, capacity 2 ounces. Each . . .10

269. Lever and Supporting Bar. The lever is a 30-centimeter section from a meter-rod, pivoted upon the smooth cylindrical body of a brass screw, which is driven horizontally into the end of a bar of hard wood about 25 centimeters long. A brass plate, projecting from this bar and overhanging the middle of the lever, prevents the lever from tipping far, while it allows sufficient freedom of motion. The lever itself, except for a distance of 2 centimeters each side of the middle, is cut away so that its top is level with the upper part of the hole through the center. Each 50

270. Two Brass Scale Pans, 6.5 centimeters square. Each pan is suspended by four strong linen threads meeting in a knot about 20 centimeters above the pan, two of them continuing in a loop about 4 centimeters long above this knot. Per pair 20

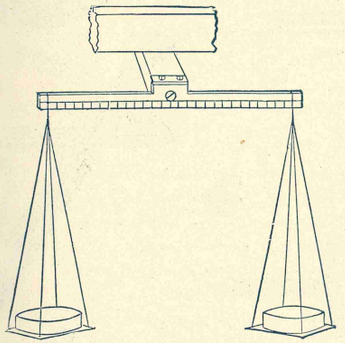
271. Set of Iron Weights, 8 ounces, 4 ounces, 2 ounces, and two 1 ounce, making a total of 16 ounces. No weight is in error more than one grain. Per set 60

272. Cubical Block of Wood, 3.7 centimeters on each edge. The top is slotted and the lower part grooved. A binding screw extends through the latter, and serves to hold the block in position upon a meter-rod. Each . . .15

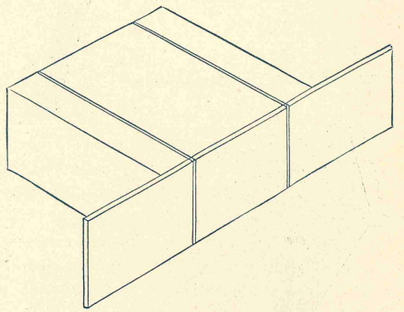
No. Price.

273. Pieces of wood for supporting Spring Balance in a horizontal position. Per pair . . . . . $ .05

274. Plate-glass Mirror, 4 x 15 centimeters. The coating on back is protected by paint. Each 15



269 and 270



261 and 274

275. Straight-edged White Pine Rulers, 30 centimeters long, 5 centimeters wide, and 1 centimeter thick. Per pair 15

276. Cubical Block, like No. 272, but without the screw. One side is coated with white paper, and a vertical mark is made across the middle of this paper. Each 10

277. Walter Smith School Square. Each 10

278. Cylindrical Mirror of nickel-plated brass, 4 centimeters tall and 5 centimeters wide, mounted upon a semi-circular base of proper thickness and radius of curvature. Each 50

279. Brass Partition, made to fit jar No. 267. Each 15

280. Index of thin sheet brass, made so that it will clasp the side of jar No. 267. Each 05

281. Circular Double Convex Lens, 15 centimeters focus, mounted upon a cubical block similar to No. 272, and held in place by two brass strips. Each . .30

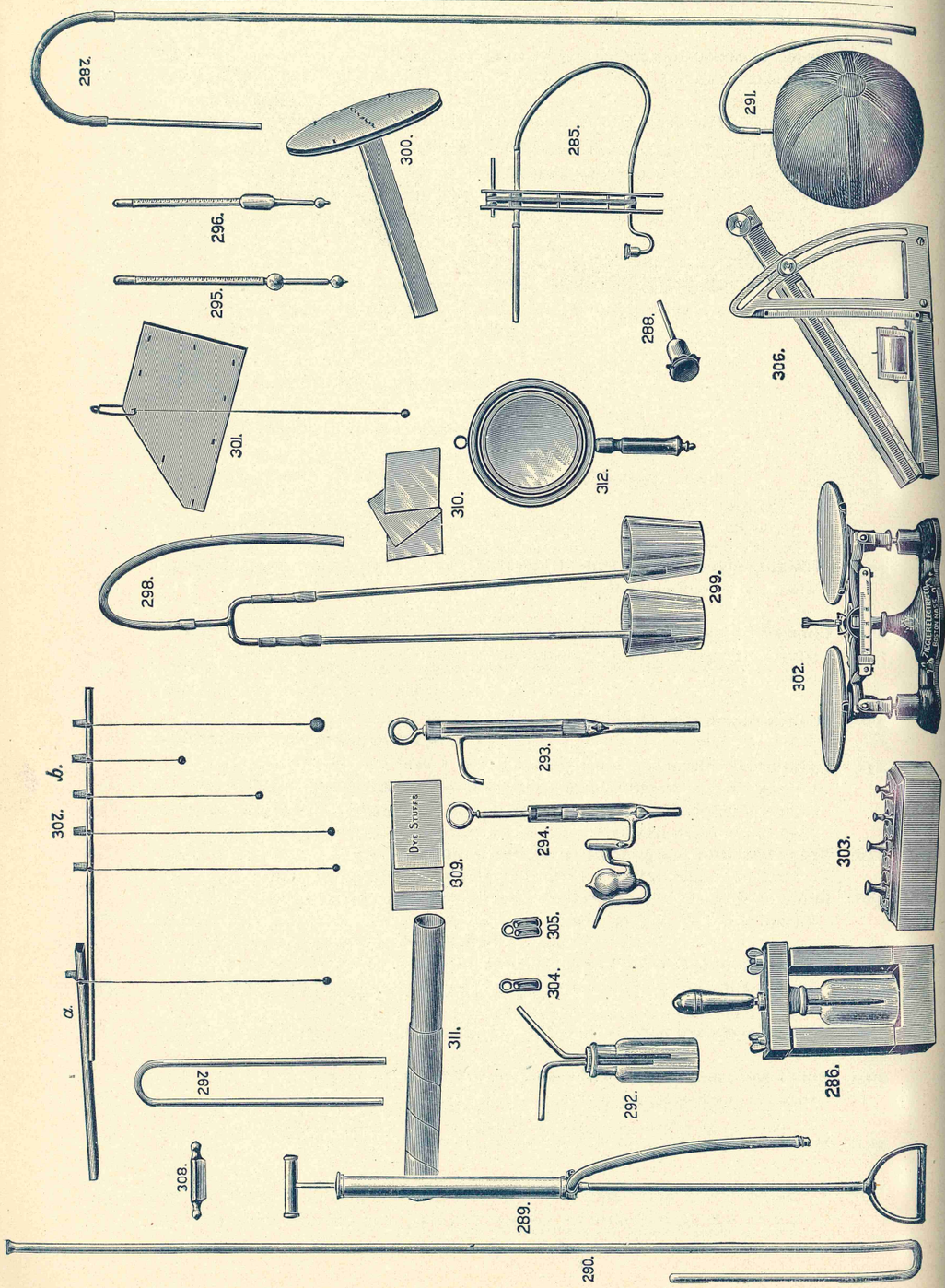
282. White Cardboard Screen, 8 centimeters square, of proper thickness. Each .05

283. Small Kerosene Lamp, with asbestos shade. A small hole is cut in the shade at the height of the flame. Each 40

284. Wire of proper size to fit slot of No. 272, bent at a right angle. Each . . .04

284b Blocks, similar to No. 272, for supporting meter-rod No. 252. Per pair . .20

Two of these blocks are required for each meter-rod.



Apparatus Required by the Teacher. — Ziegler Electric Company, Manufacturers, No. 141 Franklin Street, Boston, Mass.

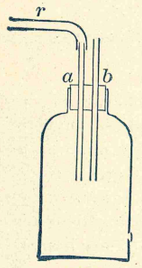
Lecture-Room Outfit.

NOTE. — This list constitutes a set of apparatus required by the teacher, and is not to be furnished to the pupil. Price of set, complete, $30.00.

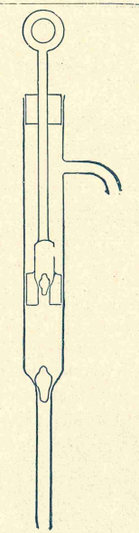
Single pieces of apparatus will be furnished at the prices affixed to such articles.

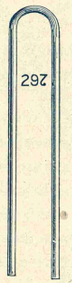
When ordering single pieces, please order by number.

No.		Price.
285.	**Gauge** for testing pressure at various points and in various directions in a jar of water. Strict attention has been given to the mechanical construction of this piece of apparatus. We feel sure that an examination will show that the gauge which we offer is not only more durable, but that it is a much more efficient gauge than any similar instrument on the market. Metal columns have been employed in place of the troublesome wooden columns which are used in the cheaper gauges. This is but one of the many highly essential changes which we have made in the construction of these gauges. Each	$1.00
	(For price of lamp chimney and cork used with pressure gauge, see miscellaneous apparatus No. 322.)	
286.	**Apparatus for Bursting a Bottle** by an attempt to compress water within it. A very unique, effective, and durable form. Each	1.00
	(Extra wide-mouth bottles will be furnished at 35 cts. per doz.)	
287.	**Two Strong Glass Tubes,** of uniform bore, respectively 1 meter and 20 centimeters long, connected together by a strong rubber tube 25 centimeters long. The longer tube is closed at one end. Apparatus complete, as described	.75
	(For price of support for the above, see miscellaneous apparatus No. 323.)	
288.	**Strong Thistle Tube,** 2.5 centimeters diameter, covered at the mouth with strong sheet rubber, including a thick-walled rubber tube 20 centimeters long, ready for use. Each	.25
289.	**Nickel-plated Condensing and Exhausting Air-Pump,** cylinder 1 x 11 ins., made in the most thorough manner. The valves are made of aluminum. An arrow embossed upon each valve-chamber indicates the direction of the air current. Each	3.00
290.	**Mariotte's or Boyle's Law Tube,** well made and of even bore, 1.5 meters long. Each	1.00
291.	**Large and Strong Rubber Foot Ball,** with 30 centimeter rubber tube attached to key. Each	1.00
292.	**Small Bottle,** provided with rubber stopper, fitted with two glass tubes. Each	.40



292


293

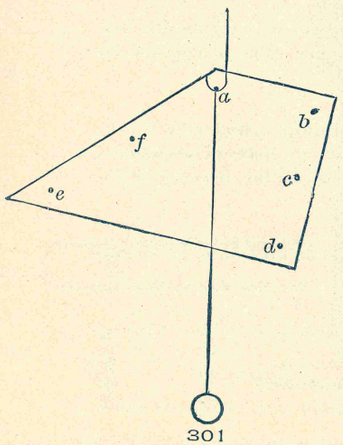


297

No.		Price.
293.	**Glass Model of Lifting Pump,** well made and of good size. Each	$1.25
294.	**Glass Model of Force Pump,** of improved form and well made. Each	1.25
295.	**Hydrometer,** for liquids less dense than water, of excellent quality. Each	1.00
296.	**Hydrometer,** ,, ,, more ,, ,, ,, ,, ,, ,, ,,	1.00
297.	**U=shaped Glass Tube,** each arm 30 centimeters long. Each	.25
298.	**Glass Y=tube,** with attached rubber and glass tubes. Each	.45
299.	**Small Glass Tumblers.** Per pair	.10
300.	**Eight=inch and four=inch Wooden Discs** combined in one piece, for use as a pulley. This piece is mounted much like the lever of No. 269. Each	1.00

☞ Lead Y-tubes will be furnished with No. 298 when so ordered, at an additional outlay of fifteen cents.

Parties preferring Lead Tubes should so specify when ordering ; otherwise, Glass Tubes will be furnished.



301

301.	**Center of Gravity Board,** with suspension and plummet	.50
302.	**Ziegler Electric Company's Improved Trip Scale,** capacity, 2 kilograms to 1 decigram. Each	5.65
	(This balance is offered as an improvement over any similar balance upon the market. It has an upright indicator, and the adjustable nuts are more conveniently located.)	
303.	**Set of Weights,** brass, in block, 500 grams to 1 gram	2.00
304.	**Well=made, small, single Brass Pulley.** Each	.25
305.	**Well=made, small, double Brass Pulley.** Each	.50

No.		Price.
306.	**Adjustable Inclined Plane,** shown about one-third actual size in cut. The roller is made of brass and accurately turned. It weighs, with its frame, just 16 ounces. The scale is graduated into millimeters. Great care has been exercised in making this piece. Each	$4.25
307.	**Two systems of Pendulums,** with supports (*a* and *b*), nicely constructed and ready for use	1.00
308.	**Prism of Flint Glass,** 4 ins. long. Each	.30
309.	**Three packages of Dye Stuffs,** different colors. Each	.10
310.	**Three Glass Plates,** different colors, 10 centimeters square. Each	.10
311.	**Camera Obscura**	.50
312.	**Spherical Mirror,** 12 or 15 centimeters in diameter, concave on one side and convex on the other, neatly mounted in polished hard-wood frame, with handle	2.25

Miscellaneous Articles.

313.	**Mercury** (2 lbs.). Per lb.	.80
314.	**Para Rubber Cloth Insertion Tubing,** $\frac{3}{16}$ in. bore, 6 ft., specially adapted for use with air-pumps, and unequalled for durability. Per ft.	.15
315.	**Thin Sheet Rubber.** Per oz.	.25

316

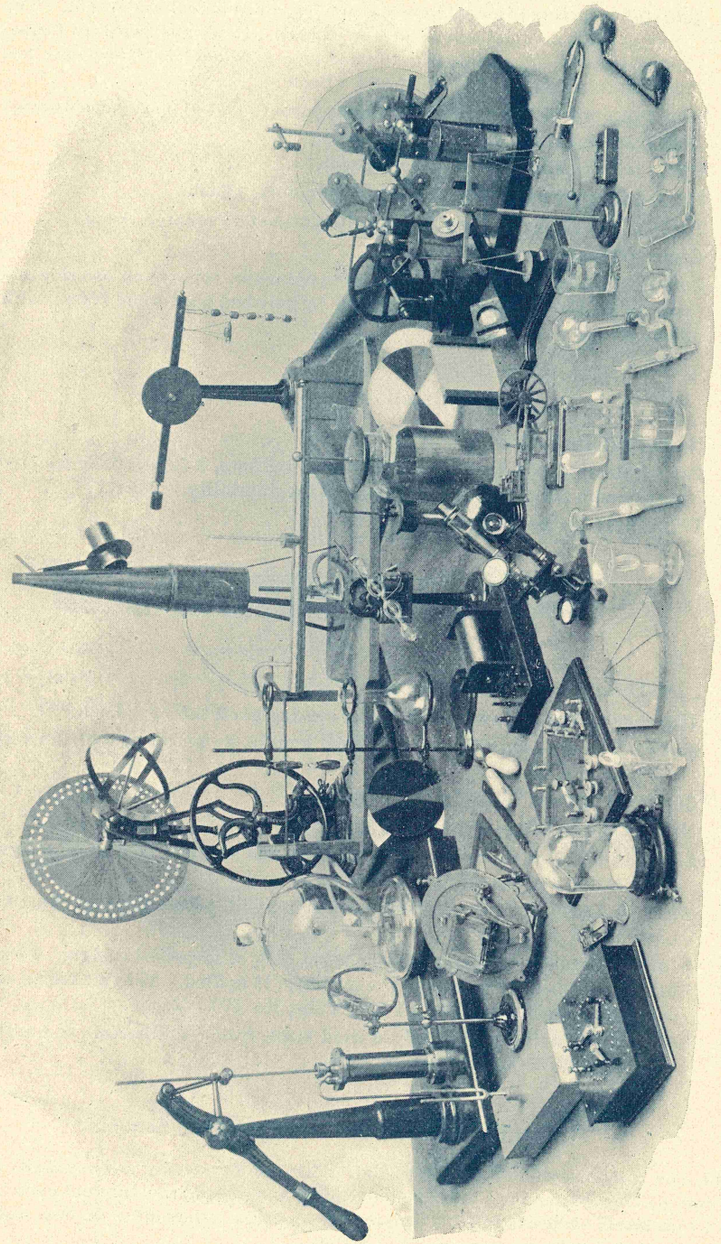
316.	**Cork=borers,** hard brass, six to set. Per set	1.00
317.	**Three=cornered File,** with handle, for cutting glass tubing. Each	.12
318.	**Screw=driver,** 4 ins., with twisted steel handle, an excellent tool at a very low price. Each	.10
319.	**Compound Lever Wire Cutters.** Each	1.00
320.	**Naked Copper Wire,** No. 16 B. & S. Gauge. Per $\frac{1}{2}$ lb.	.25
321.	**Small Bottle** containing 2 ounces mercury and an equal volume of chloroform, water, and kerosene. Each	.30
322.	**Student Lamp Chimney,** with cork, for use with pressure gauge No. 285. Each	.10
323.	**Wooden Support** for Barometer Tube No. 286, of improved design. To its base is attached a rim to hold the mercury, if spilled. This makes an excellent support for our Boyle's Law Tube, No. 290. Each	.85
324.	**Soft Glass Tubing** (2 lbs.), of assorted sizes, from 2 millimeters to 8 millimeters inside diameter. Per lb.	.35

Program Clocks for Colleges and Schools.

It is now unnecessary to dilate on the advantages of a system of automatically signalling to the various class-rooms the times of commencing and closing the different exercises.

Various forms of clocks for this purpose are available ; they differ in cost and in applicability to particular circumstances.

We shall be pleased to advise as to the most desirable form in any instance and quote prices.



MISCELLANEOUS GROUP OF PHYSICAL APPARATUS.

List of Apparatus Adapted to Gage's "Laboratory Manual and Note-Book."

The following list is a liberal estimate of apparatus required for ten pupils, and may be varied in proportion to the size of the class. In consideration of several pieces of the same kind being taken, small reductions on the prices of single articles, as given in the foregoing catalogue, are made in some instances, but it must be distinctly understood that *no reduction in price will be made unless the number of articles of each kind ordered at one time is as great as specified in the following list:—*

General Apparatus for Mechanical Measurements.

	Price.
3 Protractors	$ .45
3 Calipers, double	1.10
1 Caliper, Metric Micrometer, Columbia	6.00
4 Yardsticks	.45
4 Meter Sticks, metal-tipped, with Metric and English Divisions	1.20
10 Metric Rules, 30 centimeters	.20
2 Graduates, Cylinders, 50 cubic centimeters	1.15
1 Graduate, Conical, 100 cubic centimeters	.60
8 Balances for Specific Gravity, with 8 sets of weights, 20 grams to 1 centigram, in block	22.00
1 Balance, platform, Harvard, scale beam sensitive to 1 decigram, with set of brass weights in block, 1 kilogram to 1 gram	8.90
1 Balance, spring, 48 lbs.	.25
6 Balances, spring, 24 lbs.	.70
6 Balances, spring, 4 lbs., with nickel-plated scale, graduated on one side in 25 gram intervals, and on the other side in 1 ounce intervals	1.40

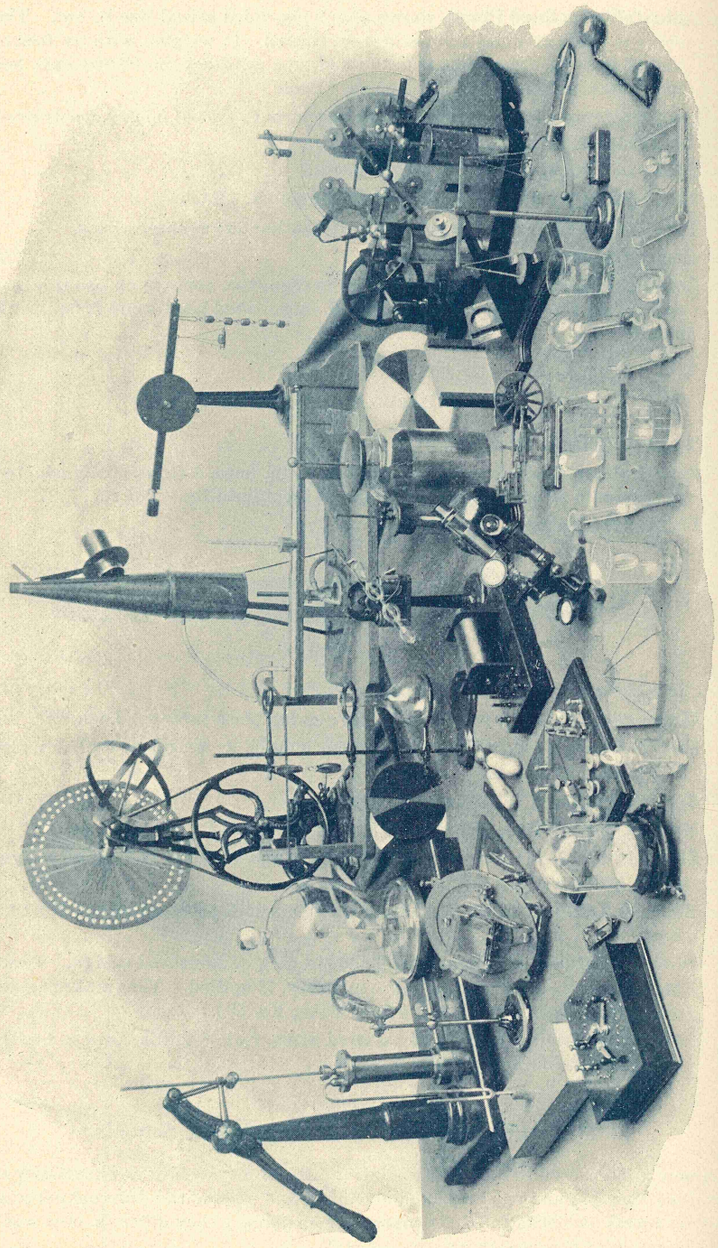
General Exercises.

The numbers enclosed in parentheses indicate the exercises in the Manual in which the apparatus is used.

10 Circular Pieces of Tin (8)	.15
2 Iron Balls and 4 Wooden Blocks (16)	.30
Brass Cylinder (17)	.35
Brass Tube (18)	.20
4 Plain Tumblers and Board (46, 51)	.25
5 Pieces of Window Glass, 3 x 4 ins. (20)	.20
Apparatus for Exercise 22 (except the weights), including three kinds of wire, ready for use	.75

Dynamics of Fluids.

Capillary Tubes, straight (23)	.10
2 Capillary Tubes, U-shaped (25)	.40
Package Cambric Needles (26)	.10
Set Bended Glass Tubes (28, 29, 30)	1.50
2 Hydrometer Jars, 15 x 2 ins. (29, 53, 106)	1.00
Bended and Jointed Glass Tubes adapted to (31 and 51)	.45
Glass Jar (30)	.30
Brass Clamp (31)	.20
Barometer Tube, Straight, and Glass Cup (32)	.55
Mariotte's Tube (33) mounted, $1.85. Same, unmounted	.85
Barometer (see Fig. 7a, Ex. 33. Also, Cat. No. 334)	6.00
Vacuum Gauge, without mercury (34)	.80
Glass U-tube, each arm 30 ins. long (37)	.75
Seven-in-one Apparatus (35, 38, 39, 40)	6.50



MISCELLANEOUS GROUP OF PHYSICAL APPARATUS.

List of Apparatus Adapted t
Manual and No

The following list is a liberal estimate of appara
varied in proportion to the size of the class. In co
kind being taken, small reductions on the prices o
catalogue, are made in some instances, but it must
in price will be made unless the number of articles of e
specified in the following list:—

General Apparatus for Mecha

3 Protractors . . . . . .
3 Calipers, double . . . . . .
1 Caliper, Metric Micrometer, Columbia . .
4 Yardsticks . . . . . .
4 Meter Sticks, metal-tipped, with Metric and En
10 Metric Rules, 30 centimeters . . . . .
2 Graduates, Cylinders, 50 cubic centimeters .
1 Graduate, Conical, 100 cubic centimeters .
8 Balances for Specific Gravity, with 8 sets of w
in block . . . . . .
1 Balance, platform, Harvard, scale beam sensit
brass weights in block, 1 kilogram to 1 gra
1 Balance, spring, 48 lbs. . . . . .
6 Balances, spring, 24 lbs. . . . . .
6 Balances, spring, 4 lbs., with nickel-plated sca
gram intervals, and on the other side in 1 c

General Exer

The numbers enclosed in parentheses indicate t
apparatus is used.

10 Circular Pieces of Tin (8) . . . .
2 Iron Balls and 4 Wooden Blocks (16) . .
Brass Cylinder (17) . . . . . .
Brass Tube (18) . . . . . .
4 Plain Tumblers and Board (46, 51) . . .
5 Pieces of Window Glass, 3 x 4 ins. (20) . .
Apparatus for Exercise 22 (except the weights),
ready for use . . . . . .

Dynamics of F

Capillary Tubes, straight (23) . . . .
2 Capillary Tubes, U-shaped (25) . . . .
Package Cambric Needles (26) . . . .
Set Bended Glass Tubes (28, 29, 30) . . .
2 Hydrometer Jars, 15 x 2 ins. (29, 53, 106) .
Bended and Jointed Glass Tubes adapted to (31 an
Glass Jar (30) . . . . . .
Brass Clamp (31) . . . . . .
Barometer Tube, Straight, and Glass Cup (32) .
Mariotte's Tube (33) mounted, $1.85. Same, unm
Barometer (see Fig. 7a, Ex. 33. Also, Cat. No. 33
Vacuum Gauge, without mercury (34) . .
Glass U-tube, each arm 30 ins. long (37) . .
Seven-in-one Apparatus (35, 38, 39, 40) . .

	Price.
Set of Heavy Iron Weights, 16 lbs. to 1 lb. (40, 70, etc.)	$3.50
Set of Bended Glass Tubes (46)	.80
Glass U-tube, each arm 12 ins. long (41)	.25
Archimedes' Apparatus (47)	1.00
Package of choice specimens of various substances (48)	.25
Specific Gravity Bottle, 100 cubic centimeters, with ground-glass stopper and counterpoise (50)	2.25
Balance, mounted on box with drawer, beam elevator, without weights (50, 54, etc.)	3.00
Demonstration Hydrometer (52)	.20

General Dynamics.

2 Desideratum Apparatus (58, 60, 76, 77, 78, 79)	10.00
Metal Arc (61)	.60
Loaded Circular Board, Spindle, Plumb-line, and Bob (62, 63, 64)	1.00
Beam with Hooks, Set of Weights, Pulley, ready for use (65)	1.50
Atwood's Machine (72, 73, 74)	20.00
Inclined Plane, Iron Roller (D. Fig. 31), about 9 lbs., Sleigh, etc., without weights (80, 81, 82, 83, 84, 85, 86, 87)	3.25
5 Iron Balls with holes through the centers (88, 89, 90)	.50

Heat.

General Apparatus Required.

10 Flasks, different sizes	2.25
4 Nests of Beakers	2.80
3 Dozen Test Tubes	.90
4 Chemical Thermometers, — 10° to 300° C.	4.50
4 Ring-stands	2.80
2 Clamps for Ring-stands	2.00
4 Pieces of Wire Gauze	.28
6 Bunsen Burners	1.80
1 Bunsen Burner, with 3 tubes	1.20
3 Test-tube Holders	.35
4 Tin Sand Baths	.20
Rubber Gas Tubing, per ft.	.12

Special Apparatus.

Wires of different metals (91)	.25
Glass Tube, with Bulb (97)	.15
Wolpert's Air Tester, with Stand (98)	1.50
Ring and Ball (99)	.80
Flask, with Side Tube (101)	.45
Condenser (106)	2.00
Bellows (107)	.75
Nickel-plated Calorimeter for finding "dew point" (107)	.45
Model of Steam Engine (114)	2.25

Electricity and Magnetism.

General Apparatus Required.

½ lb. Copper Wire, No. 18	.25
10 Connectors, double	1.10
10 Bunsen Cells, 1 quart	18.00
1 Daniell Cell	1.45
Bar Magnet, 12 ins.	.75
2 Magnetic Needles, 6 ins.	2.40
1 Exploring Needle, compass form	.45
3 Galvanometers	16.50
3 Sets of Spools of Wire	6.75

	Price.
3 Rheostats	$12.50
3 Wheatstone's Bridges	10.50
Platinum Wire, at market price.	

Special Apparatus.

2 Sets of Cu. and Zinc Strips, with wires attached (115)	.80
1 Yard German Silver Wire (123)	.05
2 Pole-changers, switch pattern (124 *et. al.*)	2.50
4 Battery Connectors, preferred to the mercury cups, and can be used in place of triple connectors in Ex. 128, eight wires each (128, 130, 131, 132, 133, 134)	1.00
1 Incandescent Lamp (134)	1.50
Induction Coils and Stand (135, 141)	9.50
Handles to accompany the above (141)	.60
Fine Wire Sieve (144)	.50
Circular Magnetized Steel Disc (144)	.50
1 lb. Fine Iron Turnings (144)	.10

Sound.

Rubber Cord, 12 ft. (147, 148, 149)	.60
Resonance Apparatus, as in Fig. 56 (150), without stand	1.00
Sonometer (153, 154, 155, 156, 157, 158, 159)	5.00
Adjustable Tuning Fork (158, 159)	1.10
Organ Pipe with Piston (160, 161, 162)	3.50

Light.

Photometer, bank 8 ft. 6 ins. long, burner, 4 lava tips, etc. (163, 164)	7.00
English Standard Candles, each	.30
Concave Mirror (166, 167, 168, 169, 170, 171, 200)	2.25
Porte-Lumière, without lens (173, 175, 183, 184, 185, 186, 187, 192, 193, 197, 204, 206)	8.00
Adjustable Slit (173, 183, etc.)	.85
Glass Prism (173, etc.)	1.25
2 Bisulphide of Carbon Prisms (173, 183, 192, etc.)	4.25
Glass Bulb, filled with solution of sodium chloride and hermetically sealed (175)	.50
Double Convex Lens, mounted on elevating stand (176, 177, 178, 179, 180, 181, 182, etc.)	4.50
Red and Blue Glasses (184), each	.10
Tank for Liquids (185)	2.50
1 Bottle each of Permanganate of Potash, Picric Acid, Ammoniated Sulphate of Copper, Oxide of Copper (185)	.80
1 each Strips of Red and Blue Cardboard (187)	.16
1 Ounce each of Eosine and Sulphate of Quinine (188)	1.00
Spectroscope, Pocket (191)	10.00
Black Cardboard (192, etc.)	.03
Rotating Apparatus and Set of Color Discs (194)	6.00
Camel's-Hair Brush and one pan each of Chrome Yellow and Ultra-marine Blue Pigments, water-colors (195)	.40
Small Iceland Spar (196)	.50
Tourmaline Tongs (198. In addition to this exercise, require the pupil to place the slices of tourmaline so as to cut off the light; then place between the slices an ordinary glass lens of a pair of eye-glasses; afterwards substitute for the glass lens a pebble [quartz] stone lens, such as are much used in eye-glasses. The latter will so twist the plane of vibration of the polarized ray as to admit of its passing through the farther slice. In this way pebble lenses may easily be distinguished from glass lenses.)	3.00
Polariscope (199)	5.00
Specimen of Mica mounted on glass (199)	1.00
Telescope (201, 202)	2.50

Physical Apparatus in Sets.

The following sets have been carefully compiled by us with a view to rendering assistance to inexperienced teachers in schools of limited financial facilities, who desire to obtain apparatus with which they can accomplish a maximum of work at a minimum of cost.

The different articles comprising these sets are all taken from our regular stock, and in quality and finish identical with the same articles priced in the foregoing catalogue bearing corresponding numbers. Intending purchasers are at liberty to substitute any apparatus of equal value from the foregoing pages for any of the articles given in these sets.

Set No. 1. This will answer very well for illustrating a large proportion of the leading experiments as laid down in the latest text-books on Physics for High Schools and Academies.

Set No. 2. To such schools as are not limited to $100.00, this set is recommended, as it affords the means for a greater range of work than does set No. 1.

Set No. 3. This is a very complete and most excellent working set of apparatus. It will serve to illustrate very fully the leading experiments as laid down in the latest text-books on Physics for High Schools and Academies.

Set No. 1. Price, $100.00.

Matter and Mechanics.

Cat. No.		Price.
63.	Meter Rod, with metal tips	$ .30
169.	Set of 4 Straight Capillary Tubes	.10
173.	Pair of U-shaped Capillary Tubes	.40
220.	Rotating Apparatus	5.00
222.	Double Elastic Brass Ring	2.00
221.	Glass Globe filled with colored liquid	.75
218.	Second Law of Motion Apparatus	2.00
240.	Mechanical Powers Apparatus	5.50
111.	Pair of 25 lb. Spring Balances	.25
227.	5 Iron Balls with holes through their centers	.60
206.	Witch	.15
		$17.05

Hydrodynamics.

279a.	Glass Siphon, plain	$ .25
293.	Glass Model of Lifting Pump	1.25
249.	Cartesian Diver, with jar and rubber	.75
265a.	Demonstration Hydrometer	.20
267a.	Glass Hydrometer for both light and heavy liquids	1.50
95.	Specific Gravity Balance	2.50
272a.	Packages Specific Gravity Specimens	.25
116.	Set of Metric Weights, 20 grams to 1 centigram	.55
257a.	Archimedes' Principle : cylinder and bucket of brass	1.00
		$9.50

Pneumatics.

296a.	Air-Pump	$23.50
301a.	Bell Glass Receiver, 2 gallons	2.00
322a.	Bottle of Pump Oil and Oiler	.25
325.	Glass Tube, with Bulb to show expansive power of air	.15
289a.	Seven-in-one Apparatus	6.50
332.	Barometer Tube, straight	.45
333.	1 lb. Mercury and Bottle	.80
330.	Mariotte's Law Tube	.85
		$34.50

Heat.

531.	1 lb. Glass Tubing, assorted sizes	$ .35
32.	1 Gross Corks, assorted sizes	1.00
29.	Round File for Cork Boring	.12
	Alcohol Lamp, No. 397, or Bunsen Burner, No. 412	.35
541.	3 ft. Rubber Tubing for connections	.30
512.	1 doz. Test Tubes, assorted sizes	.30
448.	Iron Ring-Stand, with 3 rings	.75
447.	Tin Sand Bath	.05
442.	Piece Wire Gauze, 4 x 4 ins.	.08
493.	Chemical Thermometer "C"	1.25
522.	Round Bottom Flask, with stopper	.40
476.	Set Wires of different metals, arranged in suitable manner for testing their relative conductivities	.25
	Amount forward,	$5.20

Heat. — *Continued.*

Cat. No.		Price.
	Amount brought forward,	$5.20
477.	Convection Apparatus	.80
463.	Brass Ring and Ball to illustrate expansion	.80
485.	Condenser for distillation	2.00
464.	Air Thermometer	.25
489.	Model Steam Engine	2.25
		$11.30

Electricity and Magnetism.

	6 Pith Balls and Rod of Sealing Wax	$ .35
1041.	Bar Magnet, 12 ins.	.75
1055.	Magnetic Needle	.60
1053.	Circular Magnetized Steel Disc	.50
1054.	1 lb. Fine Iron Turnings	.10
895.	Strips of Copper and Zinc to illustrate simple voltaic cell	.40
920.	1 Cell Grenet Battery, 1 qt.	2.25
	Copper Wire, insulated, assorted sizes, a selection	.50
	2 Double Connectors	.20
950.	Galvanometer	6.00
985.	Rheostat	4.50
937.	6 in. Round Norway Iron	.05
938.	Spool for Electromagnet	.30
1141.	Electric Motor, No. 1	3.00
		$19.50

Sound.

Cat. No.		Price.
349.	Rubber Cord, 12 ft. long	$ .60
379.	Sonometer	5.00
366.	Tuning Fork, Middle C, 256 double vibrations	1.25
363.	Organ Pipe with piston	3.50
		$10.35

Optics.

556.	Thick Plate Glass Mirror	$ .30
554.	Spherical Mirror, concave on one side and convex on other	2.25
616.	Package Colored Papers	.10
611.	Set of Small Colored Discs	.50
578.	Glass Prism, narrow faces, 4 ins.	.40
574.	Set of 6 Demonstration Lenses	1.00
600.	Specimen of Iceland Spar	.50
		$5.05

Summary.

Matter and Mechanics	$17.05
Hydrodynamics	9.50
Pneumatics	34.50
Heat	11.30
Electricity and Magnetism	19.50
Sound	10.35
Optics	5.05
List price of this set	$107.25
Cases, Packing and Drayage	1.25
Total	$108.50
Net price of set	$100.00

Set No. 2. Price, $270.00.

Matter and Mechanics.

Cat. No.		Price.
63.	Meter Rod, with metal tip	$ .30
169.	Set of 4 Straight Capillary Tubes	.10
173.	Pair U-shaped Capillary Tubes	.40
220.	Rotating Apparatus	5.00
222.	Double Elastic Brass Ring	2.00
223.	2 Metal Balls, in frame	1.50
221.	Glass Globe filled with colored liquid	.75
219.	Second Law of Motion Apparatus	2.00
	Amount forward,	$12.05

Cat. No.		Price.
	Amount brought forward,	$12.05
234.	2 Ivory Balls	3.00
112.	2 Spring Balances, capacity 64 ounces to 1 ounce, or 2,000 grams to 25 grams	.50
227.	5 Iron Balls with holes through their centers	.60
207.	Loaded Circular Board and Spindle	.80
206.	Witch	.15
244.	Inclined Plane	4.25
240.	Mechanical Powers Apparatus	5.50
		$26.85

Hydrodynamics.

Cat. No.		Price.
245.	Equilibrium Tubes	$ .70
293.	Glass Model of Lifting Pump	1.25
294.	Glass Model of Force Pump	1.25
295a.	U-shaped Tube to show the principle of hydrostatic press	.25
282a.	Glass Model of Hydraulic Press	1.50
256a.	Pascal's Vases	3.50
253a.	Jar with rubber bottom to show downward pressure of the atmosphere	1.00
265a.	Demonstration Hydrometer	.20
267a.	Glass Hydrometer for both light and heavy liquids	1.50
95.	Specific Gravity Balance	2.50
116.	Set of Metric Weights, 20 grams to 1 centigram	.55
261a.	Specific Gravity Bottle, 25 grams	.85
103.	Platform Balance	5.65
119.	Set of Metric Weights, 500 grams to 1 gram	2.00
257a.	Archimedes' Principle: cylinder and bucket of brass	1.00
	Water Hammer	.80
279a.	Glass Siphon, plain	.25
		$24.75

Pneumatics.

296a.	Air-Pump	$23.50
301a.	Bell Glass Receiver, 2 gallons	2.00
322a.	Bottle of Pump Oil and Oiler	.25
325.	Glass Tube with Bulb to show expansive power of air	.15
212.	Feather and Guinea Tube	7.00
324a.	Thin Rubber Foot Ball	.85
289a.	Seven-in-one Apparatus	6.50
332.	Barometer Tube, straight	.45
334.	Mercurial Barometer	6.00
331.	Mariotte's or Boyle's Law Apparatus, complete	1.85
333.	2 lbs. Mercury and Bottle	1.50
320a.	Vacuum Gauge without Mercury	.80
		$50.85

Heat.

531.	1 lb. Glass Tubing	$ .35
32.	1 Gross assorted Corks	1.00
29.	Round File for Cork Boring	.12
30.	Three-cornered File for cutting Brass Tubing, etc.	.12
	Alcohol Lamp, No. 397, or Bunsen Burner, No. 412	.35
541.	3 ft. Rubber Tubing for connections	.30
	Amount forward,	$2.24

Cat. No.		Price.
	Amount brought forward,	$2.24
512.	1 dozen Test Tubes, assorted sizes	.30
448.	Iron Ring-Stand with 3 Rings	.75
447.	Tin Sand Bath	.05
442.	Piece Wire Gauze, 4 x 4 ins.	.08
493.	Chemical Thermometer "C"	1.25
485.	Condenser for Distillation	2.00
522.	Round Bottom Flask and Stopper	.40
476.	Set of Wires of different metals arranged in a suitable manner for testing their relative conductivities	.25
477.	Convection Apparatus	.80
463.	Brass Ring and Ball to illustrate expansion	.80
475.	Compound Bar for showing unequal dilation of different metals	.65
464.	Air Thermometer	.25
440.	Pair Hand Bellows	.75
460a.	Calorimeter of nickel-plated spring brass	.45
489.	Model of Steam Engine	2.25
		$13.27

Electricity and Magnetism.

	6 Pith Balls and Rod of Sealing Wax	$ .35
871.	Friction Cylinder of Glass, one end closed	.20
894.	2 Egg Shells covered with tin foil	.30
875.	Tœpler-Holtz Electric Machine	23.50
880.	Leyden Jar, capacity 3 quarts	2.25
882.	Leyden Jar Discharger	1.00
884.	Cat Skin	.75
1041.	Bar Magnet, 12 ins.	.75
1049.	Horseshoe Magnet, 8 ins.	1.00
1056.	Magnetic Needle, with Agate Bearing	1.20
1057.	Dipping Needle	1.75
1053.	Circular Magnetized Steel Disc	.50
1054.	1 lb. Fine Iron Turnings	.10
895.	Strips of Copper and Zinc to illustrate simple voltaic cell,	.40
910.	4 Cells Type "S" Edison LaLande Battery	11.40
	Amount forward,	$45.45

Electricity and Magnetism.— *Continued.*

Cat. No.		Price.
	Amount brought forward,	$45.45
	Copper Wire, Insulated, assorted sizes, a selection	1.00
	2 Double Connectors	.20
950.	Galvanometer	6.00
1002.	Set of 5 Spools of Wire	2.40
985.	Rheostat	4.50
991.	Wheatstone Bridge	3.75
949.	V-Tube and Platinum Electrodes for Electrolysis	.50
945.	Apparatus for decomposing water	2.50
1077.	Primary and Secondary Coils	9.50
937.	6 in. Rod Norway Iron	.05
938.	Spool for Electromagnet	.30
1165.	Pair of Handles for Shocks	.60
1138.	Magneto-electric Generator	5.00
1140.	Model of Gramme Machine	3.50
1143.	New Combination Motor, with Geissler Tube Attachment	9.00
1082.	Ruhmkorff Induction Coil, ½ in. spark	8.50
1095.	Geissler Tube, 6 in.	.75
	Incandescent Electric Lamp, unmounted, 3 or 4 c. p.	1.00
1151.	Sounder and Key mounted together on iron base	3.25
		$107.75

Sound.

349.	Rubber Cord, 12 ft. long	$ .60
365.	Diapason	2.25
352.	Tin Tube, 11 ft. long	2.25
353.	Rose Burner and Gas Tube	1.00
224.	Siren Disc of Metal	1.25
225.	Attachment for use with last	2.50
363.	Organ Pipe with piston	3.50
	Amount forward,	$13.35

Cat. No.		Price.
	Amount brought forward,	$13.35
378.	Chladni's Plate and Savart's Bell, complete	4.50
356.	Interference Tube, tin	1.25
379.	Sonometer	5.00
391.	Heavy Bass Bow	1.25
		$25.35

Optics.

556.	Thick Plate Glass Mirror	$ .30
554.	Spherical Mirror, concave on one side and convex on the other	2.25
554.	Reflection Apparatus	.85
574.	Set of 6 Demonstration Lenses, 2 in. diameter	2.25
581.	Glass Prism, 60°, faces, 110 x 45 millimeters	1.25
600.	Specimen of Iceland Spar	.50
606.	Pocket Spectroscope	10.00
610.	Newton Color Disc, large, and five other interesting color discs	1.00
704.	Microscope, school model	18.00
		$36.40

Summary.

Matter and Mechanics	$26.85
Hydrodynamics	24.75
Pneumatics	50.85
Heat	13.27
Electricity and Magnetism	107.75
Sound	25.35
Optics	36.40
List price of this set	$285.22
Cases, Packing and Drayage,	3.00
Total	$288.22
Net price of set	$270.00

Set No. 3. Price, $400.00.

With the exception of the unmounted incandescent electric lamp, this set includes all of the apparatus listed under Set No. 2, together with the following additional apparatus: —

Matter and Mechanics.

Cat. No.		Price.
226.	Atwood's Machine	$20.00
201.	Hard-wood Board for balancing different combinations of forces on a plane	.85
		$20.85

Pneumatics.

328.	Condensing Chamber, etc., complete	$6.00

Heat.

Cat. No.		Price.
526.	Nest of Five Glass Beakers	$ .75
525.	Long Copper Vessel on legs	3.00
478.	Wolpert's Air Tester	1.50
470.	Linear Expansion Apparatus	2.25
457.	Apparatus "A"	2.50
		$10.00

Electricity and Magnetism.

Cat. No.		Price.
1069.	Floating Cell and Connected Solenoid	$1.50
1070.	Apparatus to illustrate the action of parallel currents on one another	.75
1071.	Apparatus, same as No. 1070, with contracting helix	1.10
1127.	Dynamo Electric Machine	48.00
1134.	Incandescent Electric Lamp System, including 3 mounted 6 candle-power lamps	8.00
		$59.35

Sound.

376.	Apparatus for recording the vibrations of a tuning fork, complete	$3.25

Optics.

602.	Polariscope	$5.00
604.	Specimen of Mica	1.00
576.	Mounted Lens, 10 in. focus	4.50
620.	Porte-Lumière	8.00
621.	Disk with Adjustable Slit	.85
	Amount forward,	$19.35

Cat. No.		Price.
	Amount brought forward,	$19.35
622.	Disk with Circular Apertures	.30
624.	Electroylsis Tank	2.50
568.	Bisulphide of Carbon Prism	2.50
601.	Pair Tourmaline Tongs	3.00
546.	Photometer	7.00
551.	Standard Candle	.30
630.	Telescope	2.50
		$37.45

Summary.

List Price of Set No. 2, omitting unmounted incandescent electric lamp	$284.22
Matter and Mechanics	20.85
Pneumatics	6.00
Heat	10.00
Electricity and Magnetism	59.35
Sound	3.25
Optics	37.45
List Price of Set	$421.12
Cases, packing, and drayage	5.00
Total	$426.12
Net Price of Set	$400.00

NOTICE.

We desire to call attention to the fact that we have in addition to this publication, another catalogue devoted entirely to Electrical Supplies, Instruments, and Appliances generally, to which we would refer intending purchasers of apparatus or material not found in these pages. Price 50 cents a copy, refunded to all purchasers to the value of $5.00.

We are also prepared to execute all orders for Electric Light Wiring and to equip schools and colleges and other buildings with Electric Lighting and Power Installations, Call Bells, Gongs, Fire and Burglar Alarms, Telephone Systems, Electric Gas Lighting, etc.

Reference and Text-Books for Teachers of Physics.

	Price.
Allen's "Laboratory Physics"	$1.10
Appleton's "Physics"	1.25
Avery's "Physics"	1.25
Barker's "Physics"	3.35
Carhart & Chute's "Elements of Physics"	1.25
Chute's "Physical Laboratory Manual"	1.00
Chute's "Practical Physics"	1.25
Cummings's "Electricity Treated Experimentally"	2.25
Daniell's "Physics"	4.00
Dolbear's "Art of Projection"	1.65
Everett's "Units and Physical Constants"	1.25
Gage's "Elements of Physics"	1.10
Gage's "Introduction to Physical Science"	1.00
Gage's "Laboratory Manual and Note-Book"	.35
Gage's "One Thousand Exercises in Physics"	.50
Gage's "Principles of Physics"	1.40
Gifford's "Elementary Lessons in Physics"	.60
Hall's "Lessons in Physics"	.75
Hall & Bergen's "Text-Book of Physics"	1.25
Hall & Bergen's "Key"	.70
Harvard "Descriptive List of Elementary Physical Experiments"	.50
Hertz "Papers"	3.25
Hopkins's "Preparatory Physics"	1.25
Houston's "Electrical Dictionary"	5.00
Jamieson's "Elementary Manual of Magnetism and Electricity"	1.40
Jones's "Examples in Physics"	1.00
Lockyer's "Studies in Spectrum Analysis"	2.50
Lodge's "Mechanics"	1.20
Lodge's "Modern Views of Electricity"	2.00
Loudon & McLennan's "Laboratory Manual of Experimental Physics"	1.90
Loudon's "Rigid Dynamics"	2.25
Maxwell's "Matter and Motion"	.50
Maxwell's "Theory of Heat"	1.50
Meyer's "Sound"	1.00
Niaudet's "Electric Batteries"	2.50
Nicholl's "Laboratory Manual of Physics and Applied Electricity," Vol. I., $3.00, Vol. II.	3.25
Nicholl's & Franklin's "Elements of Physics" Vol. I.	1.50
Poyser's "Magnetism and Electricity"	.80
Report of the "Committee of Ten"	.40
Rood's "Modern Chromatics"	1.60
Sabine's "Laboratory Course in Physics"	1.25
Shaw's "Physics by Experiment"	1.00
Sloane's "Electricity Simplified"	1.00
Steele's "Popular Physics"	1.00
Stewart & Gee's "Practical Physics for Schools"	2.25
Stewart's (Balfour) "Elementary Treatise on Heat"	1.40
Stewart's "Treatise on Heat"	.90
Thompson's "Dynamo-Electric Machinery"	5.00
Thompson's (Sylvanus P.) "Elementary Lessons in Electricity and Magnetism"	1.25
Thomson's "Mathematical Theory of Electricity and Magnetism"	2.60
Webster's "Mathematical Theory of Electricity and Magnetism" (in press)	
Whiting's "Physical Measurement," third part	1.35
Wormell's "Electricity in the Service of Man"	4.50
Worthington's "First Course Physical Laboratory Practise"	1.40
Wright's "Heat," $1.40. Wright's "Light"	2.00

SPECIAL NOTICE.

MISCELLANEOUS.

INTRODUCTION TO PHYSICAL SCIENCE. By A. P. GAGE, Instructor in Physics in the English High School, Boston, Mass. $1.10

PHYSICAL LABORATORY MANUAL AND NOTE BOOK. By Same Author, .45

1000 EXERCISES IN PHYSICS. By Same Author 50

PHYSICAL TECHNICS, or, Teachers' Manual of Physical Manipulation, etc. By Same Author 1.00

PRINCIPLES OF PHYSICS. By Same Author 1.45

ELEMENTS OF PHYSICS. „ „ „ 1.25

THE ELEMENTS OF PHYSICS. By Carhart & Chute 1.20

TEXT BOOK OF PHYSICS. By Hall & Bergen 1.25

KEY TO ABOVE 70

ELEMENTARY LESSONS IN PHYSICS. By Prof. E. H. Hall 75

INTRODUCTION TO CHEMICAL SCIENCE. By R. P. WILLIAMS, Instructor in Chemistry in the English High School, Boston. 12mo. Cloth. 216 pages 90

LABORATORY MANUAL OF GENERAL CHEMISTRY. By Same Author . .30

CHEMICAL EXPERIMENTS, General and Analytical. By Same Author . . .50

FIRST PRINCIPLES OF NATURAL PHILOSOPHY. By PROF. A. E. DOLBEAR, of Tufts College 1.15

THE ART OF PROJECTING. By Same Author 1.65

LOMMEL'S "NATURE OF LIGHT" 2.00

BEALE'S "HOW TO WORK WITH THE MICROSCOPE" 7.50

MANTON'S "BEGINNINGS WITH THE MICROSCOPE" 50

ZIEGLER'S "PATHOLOGICAL ANATOMY," translated from 8th German Ed. In three parts. Each part 3.50

NOTE. — The above works are kept in stock by us, and will be forwarded to any address, postage free, on receipt of price.

Catalogue Index.

PAGE.

ADHESION DISCS 25
Adjustable Extension Poles 107
Air-Pumps 42, 43, 217
Alcohol Lamps, Glass 60
Ammeters 174, 175
Anatomical Charts 137
Anatomical Models 137
Anemometer 52
Anvils 5
Apparatus "A," for Generating Steam, etc. . . . 67
Apparatus for Experiments with Lenses 85
Apparatus for Illustrating the Principle of Electro-magnetic Induction 183
Apparatus for Recording the Vibrations of a Tuning Fork 56
Apparatus Showing Index of Refraction from Air to Water 85
Apparatus to Show Downward Pressure of Atmosphere 36
Apparatus to be Used with Gage's "Laboratory Manual and Note Book" 221–223
Apparatus to be Used with Hall's "Elementary Lessons in Physics" 213–220
Archimedes' Principle 38
Archimedes' Pump 40
Arc Lamps 109, 192
Arc, Metal 29
Asbestos Board 65
Asbestos Paper 65
Aspirator Connectors 44
Aspirators, Chapman's 44
Attachment for Siren Disc 32, 54
Attachment for Vertical Projection 92
Atlas, Klein's Star 98
Atwood's Machine 32
Aucustic Tubes 53

BALANCES 14–20
Balances, Spring 18
Balloons, Collodion 59
Balls, of Different Materials 32
Balls, Two, Metal, in Frame 31
Bar, Compound 69
Bar Magnets 176
Barometers, Aneroid 48–51
Barometers, Mercurial 43, 47
Barometer Tubes 46
Baroscope and Counterpoise, Brass 42
Bars, Cast-Iron 40
Bass Bow, Heavy Double 59
Battery Connectors 201
Battery, Floating 179
Batteries, Galvanic 141–147
Battery Jars 144
Battery Parts 141, 142
Battery, Storage 148, 149
Beads, Glass 67

PAGE.

Beakers, Copper 80
Beakers, Glass 80
Bell, Electric, for Use in Vacuum 42
Bells, Electric Call 202
Bell Glasses 43, 44
Bellows, Foot 65
Bellows and Gas Bag for Sounding Organ Pipes in an Even Tone 59
Bellows, Hand 65
Bicycle Whistle 53
Binding Posts 207, 208
Bisulphide of Carbon 87
Bisulphide of Carbon Prisms 87
Bits, Auger 5
Bit Stock 5
Blast Lamps 61
Block, Hard-wood, Rectangular 84
Block and Platform for Use with Seven-in-One Apparatus 41
Blocks, Sight and Release 33
Blow-Pipes for Brazing 65
Blow-Pipes, Mouth 64
Board, Circular, Loaded, with Spindle 29
Board, Square, Hard-wood, for Balancing Different Combinations of Forces on Plane 28
Books, Reference 229
Bolognese Flasks for Breaking 44
Bottles of Eosine and Sulphate of Quinine . . . 92
Bottles of Permanganate of Potash, Ammoniated Sulphate of Copper, etc. 92
Bottles of Salts for Spectrum Analysis 89
Bottle, Mariotte's 45
Bottles, Specific Gravity 38
Bottles for Use in Finding Specific Gravity of Air 39
Boxes for Microscope Objects 125
Boxes, Wood, for Lantern Slides 108
Breaking Strength of Wire Apparatus 26, 27
Bulb, Glass, Tubulated, for Essays on Capillarity . 25
Bunsen Burner Attachments 64
Bunsen Burners 62, 63
Burner, Rose, and Gas Tube 53
Burners, Glass Blowers' 61, 62
Burner Tips, Glass Blowers' 62
Buttons, Push 201

CALCIUM LIGHT JETS 106
Calipers 5, 11, 12
Calorimeter, Nickel-Plated, Spring Brass 67
Calorimeter, Simple, for Determining Heating Effects of the Electric Current 150
Calorimeter, Large 151
Cameras, Photo-Micrographic 119, 120, 121
Candles, Paraffine 82
Candles, Standard 82
Capillary Plates 25
Capillary Tubes 25
Cardboard Strips 92

PAGE.

Carrier, New Self-Adjusting . . . 107
Carbons . . . 203
Cat Skins . . . 141
Carriage, Metal, for Inclined Plane . . . 29
Cartesian Divers or Bottle Imps . . . 36
Charts, Anatomical . . . 137
Chisels, Cold . . . 5
Chladni's Plate and Savart's Bell . . . 56
Circulating Apparatus . . . 70
Clamp and Plates for Showing Newton's Rings . 86
Clamps for Holding Test Tubes on Side of Battery Jar . . . 79
Clocks, Program, Mention of . . . 219
Cohesion Figures . . . 25
Cohesion Hemispheres . . . 25
Cohesion Plates . . . 25
Coil of Wire for Testing Electrical Resistance with Change of Temperature . . . 171
Coils, Induction, Ruhmkorff . . . 184, 185
Coils, Primary and Secondary . . . 183
Collision Balls . . . 33
Color Charts . . . 91
Color Discs . . . 89, 90
Colored Glasses . . . 86
Colored Papers . . . 91
Color Top . . . 90
Compasses, Pocket . . . 178, 179
Compass, Universal Pencil . . . 6
Composition of Forces and Velocities . . . 28
Compound Bar . . . 69
Compressors, Mohr's Spring . . . 81
Compressors, Screw . . . 81
Concave Reflectors, Nickel-Plated . . . 70
Condensation-Trap . . . 67
Condensers for Distillation . . . 71
Condensing Chamber, etc. . . . 45
Condensing Lenses . . . 105
Conductor, Ellipsoidal . . . 141
Connectors, Wire . . . 206, 207, 208
Connectors, Battery . . . 201
Contact Keys . . . 170
Cords, Conducting . . . 201
Cord, Rubber . . . 53
Cork Borers . . . 7
Corks . . . 7
Cork Pressers . . . 7
Copper Sulphate . . . 81
Copper Vessel, on Legs . . . 80
Copper and Zinc Strips . . . 141, 142
Cradle for Spring Balance . . . 27
Crookes' Radiometers . . . 84
Crookes' Tubes . . . 187
Crova's Disc . . . 53
Cryophorus . . . 70
Crystals, Models of . . . 26
Cup, Tantalus . . . 39
Cup, Earthen . . . 25
Curvilinear Motion Apparatus . . . 30
Cylinder and Bucket, or Archimedes' Principle . 38
Cylinder Friction, Glass . . . 138
Cylinders, Glass, on foot . . . 36
Cylinder, Induction . . . 141
Cylinders, Wood, Illustrating Amperian or Molecular Currents . . . 182

DECOMPOSITION OF WATER APPARATUS, GERMAN PATTERN . . . 151, 152
Decomposition of Water Apparatus, Hoffman's . 152

PAGE.

Deflection of Magnetic Needle by Current . . . 150
Demonstration Hydrometers . . . 38
Diapason . . . 55
Diffusion of Liquids Apparatus . . . 25
Dipping Needles . . . 177
Discs, Color . . . 89, 90
Discs, Crova's . . . 53
Disc with Adjustable Slit . . . 92
Disc with Three Circular Apertures . . . 92
Disc, Siren . . . 31, 54
Discharger, Leyden Jar . . . 141
Dissecting Instruments . . . 126–131
Distillation Apparatus . . . 71, 72
Distribution of Magnetism . . . 181
Dividers . . . 6
Dolbear's "The Art of Projection" . . . 92
Dynamos . . . 189, 190, 191

EARTH-CURRENT INDUCTOR . . . 182
Egg Shells Covered with Tin Foil . . . 141
Eight-in-One Apparatus . . . 39
Elasticity of Stretching of Brass Wire . . . 27
Electric Bell for Use in Vacuum . . . 42
Electric Bells . . . 203
Electric Call-Bell Outfits . . . 202
Electric Railway . . . 197
Electrolysis Tank . . . 92
Electromagnets . . . 149, 150
Electromagnet Spools . . . 150
Electrometer, Pith-Ball . . . 141
Electrolysis Apparatus . . . 151, 152
Electroscopes, Gold Leaf . . . 141
Electrophorous . . . 138
Electrotyping Apparatus . . . 198
Ellipsoidal Conductor . . . 141
Emery Cloth . . . 6
Emery Flour . . . 6
Emery Powder . . . 6
Engines, Steam, Models of . . . 72, 73
Equilibrium Tubes . . . 36

FANS FOR MOTORS . . . 195
Files . . . 7
Fire Syringe . . . 66
Flasks, Bolognese, for Breaking . . . 44
Flasks, Florence . . . 79
Flasks with Side Tube . . . 79
Floating Battery . . . 179
Fluoroscopes . . . 188
Fluoroscope Screens . . . 189
Fluids, Mounting . . . 133
Foot Balls and Keys . . . 44
Forceps . . . 7
Forks, Tuning . . . 55
Friction Cylinder, Glass . . . 141
Friction Rod . . . 138
Freezing Water Apparatus . . . 71

GALVANOMETERS . . . 153–163
Gas Bags . . . 106
Gauge Pressure . . . 37
Gauze, Brass . . . 65
Gauze, Iron . . . 65
Geissler Tubes . . . 186
Generator, Magneto Electric . . . 191, 194
Geometric Forms . . . 26
Glass Cutters . . . 6

PAGE.

Glasses, Colored . . . 86
Glass, Hand and Bladder . . . 44
Glass Tubing . . . 80
Glass Tumblers . . . 141
Glasses, Watch . . . 132
Globe, Glass, filled with Colored Liquid . . . 31
Graduates, Metric, Cylindrical . . . 13
Graduates, Metric, Conical . . . 13
Graphophone . . . 58
Gyroscopes . . . 30

HAMMER . . . 5
Handles for Shocks . . . 201
Hollow Globe to Show that Electric Charge Resides only on Surface of Bodies . . . 141
Horseman, Balanced . . . 29
Human Skeletons . . . 137
Hydrogen Apparatus . . . 106
Hydrometers . . . 38
Hydrometer Jars . . . 38
Hygrometers . . . 76, 77, 78

ICELAND SPAR CRYSTALS . . . 87
Illuminometer . . . 193
Imps, Bottle . . . 36
Incandescent Electric Lamps . . . 192, 193
Incandescent Electric Lamp System . . . 192, 193
Inclined Planes . . . 35
Index of Refraction Apparatus . . . 85
Induction Cylinder . . . 141
Inductor, Earth-Current . . . 182
Inertia Apparatus . . . 30
Insulated Stool . . . 141
Interference Tube, Tin . . . 53
Intermittent Spring, Glass . . . 39
Iron Filings . . . 176
Iron, Norway, Round . . . 150

JARS, HYDROMETER . . . 38
Jars, Leyden . . . 141
Jar, Resonance . . . 53
Jar with Rubber Bottom to Show Downward Pressure of Atmosphere . . . 36

KALEIDOSCOPES . . . 84
Keys, Contact . . . 170
Klein's Star Atlas . . . 98
Knives, Cork . . . 7

LABORATORY LAMPS, BLAST, ALCOHOL, UPRIGHT . . . 61
Laboratory Table . . . 210
Lamps, Alcohol, Glass . . . 60
Lamps, Arc . . . 192
Lamps, Incandescent, Electric . . . 192, 193
Lamps, Kerosene, Small . . . 85
Lamp Stand and Scale for Reflecting Galvanometer 159
Lantern Objectives . . . 105
Lanterns for Projection . . . 99–105
Lantern Slides of Views . . . 108
Law of Moments Apparatus . . . 34
Lead, Roll of, for finding Specific Heat . . . 67
Leather Washers for Air-Pump . . . 44
Lenses . . . 85, 86
Lenses, Apparatus for Experiments with . . . 85
Lens, Sound . . . 59
Level, Pocket . . . 6

PAGE.

Leyden Jar Discharger . . . 141
Leyden Jars . . . 141
Linear Expansion Apparatus . . . 68, 69
Liter Blocks . . . 13
Liter Cases . . . 13
Loaded Circular Board and Spindle . . . 29
Loaded Prisms, Wood . . . 37

MAGNETS, BAR . . . 176
Magnets, Electro- . . . 149, 150
Magnets, Horseshoe . . . 176
Magnetic Needles . . . 177
Magnetometer . . . 181
Magnetized Steel Disc, Circular . . . 176
Magnifying Glasses . . . 122, 123
Manometric Flames Apparatus . . . 57
Mariotte's Bottle . . . 45
Mariotte's Law Apparatus, Complete . . . 45, 217
Mariotte's Law Tubes . . . 45, 217
Marbles, Glass . . . 28
Measures, Metric, Liquid . . . 13
Mechanical Powers . . . 34
Mercury . . . 46
Meter, Folding, Boxwood . . . 11
Meter Sticks . . . 10, 11
Metric Charts . . . 10
Metronomes . . . 59
Microphones . . . 201
Microscope Attachment for Lanterns . . . 106
Microscopes, Compound . . . 110–115
Microscopes, Dissecting . . . 116–119
Microscope Objects . . . 125
Microscope Objectives . . . 124
Microtome . . . 129
Mirror, Cylindrical, Nickel-Plated . . . 84
Mirrors, Plate Glass . . . 84
Mirror, Spherical . . . 84
Models, Anatomical . . . 137
Model of Force-Pump, Glass . . . 41
Model of Lifting Pump, Glass . . . 41
Models of Hydraulic Press . . . 40, 41
Model of Hydraulic Ram . . . 40
Model of Water Wheels . . . 40
Momentum, Apparatus Illustrating . . . 33
Motor Generator . . . 190
Motors, Electric . . . 195, 196
Mounting Materials . . . 127, 135

NEEDLES, DIPPING . . . 177
Needles, Magnetic . . . 177
Nickel-Plating Apparatus . . . 198
Nichol's Prisms . . . 88
Norway Iron, Round . . . 150
Note Book, Celestial, Poole Bros. . . . 98

OBJECTIVES, LANTERN . . . 105
Objectives, Microscope . . . 124
Objects, Microscope . . . 124
Oiler . . . 44
Oil, Pump . . . 44
Organ Pipes . . . 54
Oxygen Apparatus . . . 106

PACKAGE SPECIFIC GRAVITY SPECIMENS 39
Palm or Pulse Glass . . . 71
Pan for Suspension of Weights . . . 27
Papers, Colored . . . 91

PAGE.

Paper, Japanese . . . 125
Paper Profile, or Cross Section . . . 9
Paraffine . . . 81
Parallel Currents Apparatus . . . 180
Pascal's Vases . . . 37
Pendulums, Sand . . . 57
Pendulums, Sets of . . . 33
Pigments and Brush . . . 91
Pipes, Organ . . . 54
Pith Balls . . . 141
Physical Apparatus in Sets . . . 224–228
Photometers . . . 82, 83
Photo-Micrographic Cameras . . . 119, 120
Planes, Inclined . . . 35
Planisphere, Celestial, Poole Bros'. . . . 98
Planisphere, Revolving . . . 97, 98
Plate, Chladni's & Savart's Bell . . . 56
Plate Electrical Machine . . . 138
Pliers . . . 5
Plumb Bob . . . 5
Pocket Compasses . . . 178, 179
Polariscopes . . . 88
Polariscope Specimens . . . 88
Pole Changers . . . 171
Porte-Lumière . . . 91
Press, Hydraulic, Glass-working Model . . . 41
Press, Hydraulic, Working Model . . . 40
Pressure Gauge . . . 37
Primary and Secondary Coils . . . 183
Prisms, Bisulphide of Carbon . . . 87
Prisms, Glass . . . 86
Prisms, Nichol's . . . 88
Prisms, Loaded, Set of . . . 37
Proof Plane . . . 141
Protractors . . . 9
Pulleys . . . 33, 34
Pumps, Air . . . 42, 43, 217
Pump, Archimedes' . . . 40
Pumps, Filter, Chapman's . . . 44
Pump, Force, Glass Model . . . 41
Pump, Lifting, Glass Model . . . 41
Pump, Oil . . . 44
Pump Oiler . . . 44
Punches . . . 5
Push Buttons . . . 201

QUART MEASURE, TIN . . . 7

RADIOMETERS, CROOKE'S . . . 84
Railway, Electric . . . 197
Ram, Hydraulic, Glass Model . . . 40
Reaction Gas Wheel . . . 45
Reaction of Liquids Apparatus . . . 40
Receivers, Bell Glass . . . 43, 44
Reflection Apparatus . . . 84
Reflectors, Concave . . . 70
Resonance Jar . . . 53
Resonance Tube . . . 53
Rheostats and Wheatstone Bridges . . . 164–170
Rheostat for Arc Light . . . 109
Ring and Ball, Brass . . . 68
Ring, Brass, Double, Elastic . . . 32
Ring Stands, Iron . . . 66
Rods, Maple . . . 27
Rod, White Pine . . . 27
Rose Burner and Gas Tube . . . 53
Roll of Sheet Lead for Use in Finding Specific Heat . . . 67

PAGE.

Rosin . . . 59
Rotating Apparatus . . . 31
Rotation of Magnetic Pole Round a Current . . . 180
Rubber Cord . . . 53
Rubber Stoppers . . . 81
Rubber Tubing . . . 81
Rules . . . 8, 10, 11
Ruhmkorff Induction Coils . . . 184, 185

SALTS FOR SPECTRUM ANALYSIS . . . 89
Sand Baths . . . 66
Scales, see Balances . . . 14–20
Scales, Plotting, Boxwood . . . 7
Scales, Triangular, Boxwood . . . 7
Screens . . . 107
Screens, Tungstate of Calcium . . . 189
Sealing Wax Rods . . . 138
Second Law of Motion Apparatus . . . 30
Sets of Physical Apparatus . . . 224–228
Seven-in-One Apparatus . . . 41
Shears . . . 7
Sieve, Fine Wire . . . 6
Siphon, Glass . . . 39
Siren Disc Attachment . . . 32, 54
Skeletons, Human . . . 137
Sonometer . . . 57
Sonometer Wires . . . 59
Sound Lens . . . 59
Specific Gravity Bottles . . . 38
Specimens, Specific Gravity . . . 39
Specimens, Polariscope . . . 88
Spectroscopes . . . 88, 89
Speed Indicator . . . 6
Sphereometers . . . 13
Spools for Electromagnets . . . 150
Spools of Wire, Sets of . . . 171
Spouting Liquids Apparatus . . . 39
Spring, Intermittent, Glass . . . 39
Spring, Spiral, Brass . . . 53
Stands, Iron Ring . . . 66
Stand for Seven-in-One Apparatus . . . 41
Stool, Insulated . . . 141
Stoppers, Rubber . . . 81
Switches . . . 201
System, Incandescent Electric Lamp . . . 192, 193

TABLE, LABORATORY . . . 210
Tank, Electrolysis . . . 92
Tantalus Cup . . . 39
Tapes, Pocket . . . 11
Telegraph Apparatus . . . 198
Telephones . . . 199, 200
Telephone, Vibration . . . 57
Telescopes . . . 93, 97
Test Tubes, Side-Neck . . . 79
Test Tubes, on Foot . . . 79
Test Tube Holders . . . 79
Test Tube Racks . . . 79
Testing Sets for Electrical Measurements . . . 172, 173
Thermo-Electric V . . . 198
Thermometer, Air . . . 68
Thermometers, Chemical . . . 74
Thermometers, Household . . . 75
Thermometers, Maximum and Minimum . . . 76
Thermopyles . . . 197, 198
Tips for Glass Blowers' Burners . . . 64
Tin Tube, in parts . . . 53
Tin Foil . . . 201

PAGE.

Tœpler-Holtz Machines . . . 139, 140
Top, Color . . . 90
Tourmaline Tongs . . . 87
Tower, Leaning . . . 29
Transmission of Pressure in all Directions . . . 41
Trap, Condensation . . . 67
Trays, Galvanized Iron, Tubulated . . . 69
Tripods, Iron . . . 64, 66
Tubes, Aucustic . . . 53
Tubes, Barometer . . . 46
Tubes, Bent, Glass, Filled with Dry Air and Mercury . . . 69
Tubes, Crookes' . . . 187
Tubes, Equilibrium . . . 36
Tube, Feather & Guinea . . . 29
Tubes, Geissler . . . 186
Tube, Interference, Tin . . . 53
Tubes, Glass, U-Shape . . . 38
Tubes, Glass, Y-Shape . . . 80
Tubes, Glass, T-Shape . . . 80
Tubes, Mariotte's, or Boyle's Law . . . 45, 217
Tube with Bulb, Glass . . . 44
Telephones, Electric . . . 199, 200
Tube U, to show Principle of Hydrostatic Press, Glass . . . 41
Tube, Resonance . . . 53
Tubing, Glass . . . 80
Tubing, Rubber . . . 80
Tungstate of Calcium . . . 189
Tungstate of Calcium Screens . . . 189
Tuning Forks . . . 55
Tyndall's Apparatus for Boiling Water by Heat of Friction . . . 66
Tyndall's Specific Heat Apparatus . . . 66

PAGE.

UPWARD PRESSURE APPARATUS . . . 36

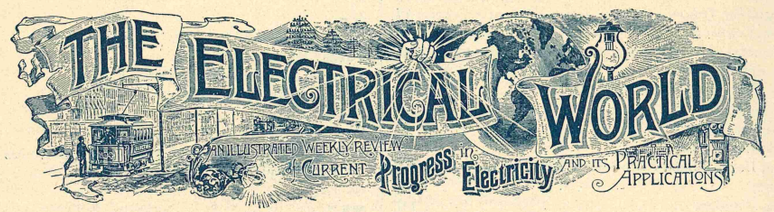
VACUUM GAUGES
Vases, Pascal's . . . 44
Vertical Projection Attachment . . . 57
Vessel, Copper, on Legs . . . 92
Vices . . . 80
Voltmeters . . . 5
V-Shaped Glass Tube and Platinum Electrodes for Electrolysis . . . 174, 175

WASHERS, LEATHER, FOR AIR-PUMP . . . 44
Watch Glasses . . . 132
Weights . . . 21–24
Wheel, Reaction Gas . . . 45
Wheels, Water, Model of . . . 40
Whistle, Bicyclist's . . . 53
Wimshurst Electrical Machine . . . 140
Wires of Different Metals, Arranged for Testing Conductivities . . . 69
Wires, Different Kinds and Sizes, Bare . . . 204
Wires, Different Kinds and Sizes, Insulated . . . 205
Wire and Electromagnet Winders . . . 202
Wire Gauges, American Standard . . . 9
Wire Gauze, Brass . . . 65
Wire Gauze, Iron . . . 65
Wolpert's Air Tester . . . 70

XYLOPHONE . . . 54

YARD-STICKS . . . 7

Pioneer Electrical Journal of America.



Most Popular of Technical Periodicals.

THE ELECTRICAL WORLD, weekly, is the largest, most handsomely illustrated and widest circulated journal of its kind in the world.

It is ably edited and is noted for popular treatment of subjects in simple and easy language, devoid of technicalities. No other technical journal has as many general readers.

THE ELECTRICAL WORLD devotes a large part of its space to alternating and multiphased currents — subjects that no one interested in Electricity can afford to neglect, and which no other electrical journal in the world treats so fully — while the Weekly Digest of Current Technical Electrical Literature gives a complete résumé of current progress in electrical science and its application both in this country and abroad.

Sample Copies Free. Agents Wanted.

ELECTRICAL BOOKS.

There is no work relating to Electricity, or kindred subjects, that is not either published or for sale at the office of THE ELECTRICAL WORLD.

Books promptly mailed, postage prepaid, on receipt of price. Catalogue and information free.

The W. J. Johnston Company,

253 Broadway, New York.

The Macmillan Company's

Scientific Publications,

THE PRINCIPLES OF THE TRANSFORMER.

By Dr. FREDERICK BEDELL, of Cornell University.

8vo. Cloth. $3.25 net.

This book contains an extensive treatment of the laws and principles governing the operation of the transformer. A feature of the work is the unity and sequence of treatment, the method of treatment being such as to make it valuable to the practising engineer as a work of reference, and to the student as a text-book.

A Laboratory Manual of Experimental Physics.

By W. J. LOUDON and J. C. McLENNAN,
Demonstrators in Physics, University of Toronto.

Cloth. 8vo. 302 pp. $1.90 net.

Elements of the Mathematical Theory of Electricity and Magnetism.

By J. J. THOMSON, M.A., F.R.S., Hon. Sc.D., Dublin.

12mo. Cloth. 511 pp. Price, $2.60 net.

A Laboratory Manual of Physics and Applied Electricity.

Arranged and Edited by EDWARD L. NICHOLS, Professor of Physics in Cornell University.

In Two Volumes. Vol. I. Cloth. Price, $3.00.

JUNIOR COURSE IN GENERAL PHYSICS. By ERNEST MERRITT and FREDERICK J. ROGERS.

Vol. II. Cloth. 444 pp. Price, $3.25.

SENIOR COURSES AND OUTLINE OF ADVANCED WORK.

By GEORGE S. MOLER, FREDERICK BEDELL, HOMER S. HOTCHKISS, CHARLES P. MATTHEWS, and THE EDITOR.

The first volume, intended for beginners, affords explicit directions adapted to a modern laboratory, together with demonstrations and elementary statements of principles. It is assumed that the student possesses some knowledge of analytical geometry and of the calculus.

A large proportion of the students for whom primarily this Manual is intended are preparing to become engineers, and especial attention has been devoted to the needs of that class of readers. In Vol. II., especially, a considerable amount of work in applied electricity, in photometry, and in heat, has been introduced.

THE ELEMENTS OF PHYSICS.

By EDWARD L. NICHOLS, B.S., Ph.D.,
Professor of Physics in Cornell University,
AND
WILLIAM S. FRANKLIN, M.S.
Professor of Physics and Electrical Engineering at the Iowa Agricultural College, Ames, Ia.

Vol. I. MECHANICS AND HEAT. 8vo. With Numerous Illustrations. $1.50, net.

Vol. II. Electricity and Magnetism. Vol. III. Sound and Light. In preparation.

JUST READY.

MISCELLANEOUS PAPERS.

By HEINRICH HERTZ,
Late Professor of Physics in the University of Bonn.
With an Introduction by Prof. PHILLIP LENARD.
AUTHORIZED ENGLISH TRANSLATION.
By D. E. JONES, B.Sc., and G. A. SCHOTT, B.A., B.Sc.

8vo. $3.25 net.

An Elementary Treatise on Rigid Dynamics.

By W. J. LOUDON, B.A.
Demonstrator in Physics in the University of Toronto.
Price, $2.25 net.

IN THE PRESS.

Christiansen.—Mathematical Physics.

Translated by W. F. MAGIE, Ph.D.,
Professor of Physics in Princeton College.

IN THE PRESS.

Mathematical Theory of Electricity and Magnetism.

By ARTHUR G. WEBSTER, Ph.D.,
Assistant Professor of Physics at Clark University, Worcester, Mass.

IN PREPARATION.

Alternating Currents and Alternating Current Machinery.

By DUGALD C. JACKSON, B.S.C.E.,
Professor of Electrical Engineering in the University of Wisconsin.

THE MACMILLAN COMPANY,

New York. **Chicago.** **San Francisco.**

CARHART & CHUTE'S,

Elements of Physics

12mo. Cloth. 388 pages. Price, $1.20.

The freshest, clearest, and most practical manual on the subject.

Now in successful use in more than one thousand schools.

ALLYN & BACON,

Publishers.

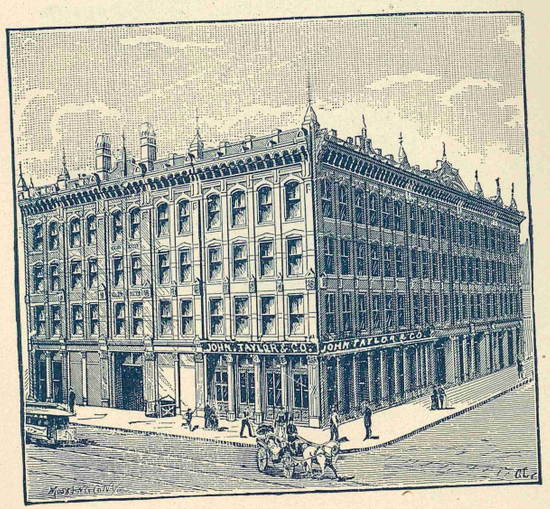
172, Tremont St., BOSTON. 355, Wabash Ave., CHICAGO.

Our Agents for the Pacific Coast,

JOHN TAYLOR & CO.,

Chemical Glassware, School and Philosophical Apparatus and Chemicals,

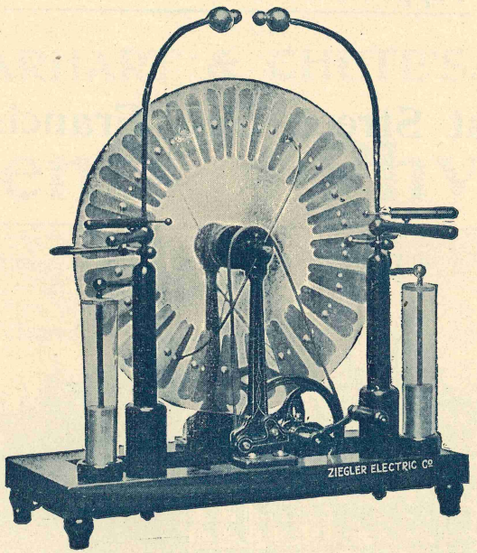
63 First Street, San Francisco, Cal.



This old and well-established house has for a number of years been acting as our agents for the Pacific Coast, and are mainly supplying the demand for school apparatus in those States and Territories. They supply all of our Physical Apparatus at our list prices, merely adding the freight. We place all our trade in that section in their hands, and refer all our customers to them. They are continually advised of all improvements and new articles in the line as they are produced.

ZIEGLER ELECTRIC CO.

HR/13510941



S77-8

"Wimshurst" Improved Self-charging Electrical Machines. See page 140.

ZIEGLER ELECTRIC CO

MANUFACTURERS

of SCIENTIFIC APPARATUS

BOSTON·MASS·

·U·S·A·

ESTABLISHED 1882.

INCORPORATED 1894